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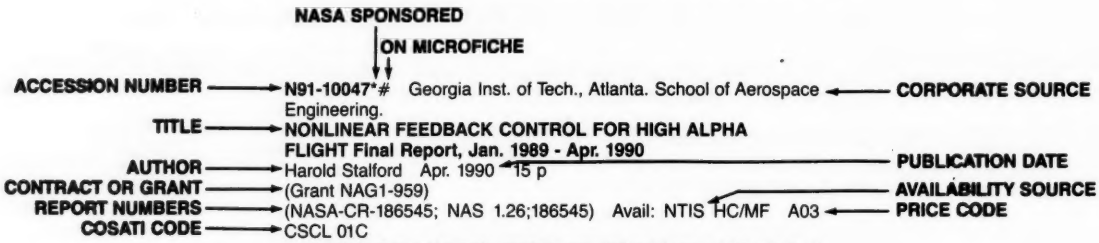

Analytical aerodynamic models are derived from a high alpha 6 DOF wind tunnel model. One detail model requires some interpolation between nonlinear functions of alpha. One analytical model requires no interpolation and as such is a completely continuous model. Flight path optimization is conducted on the basic maneuvers: half-loop, 90 degree pitch-up, and level turn. The optimal control analysis uses the derived analytical model in the equations of motion and is based on both moment and force equations. The maximum principle solution for the half-loop is poststall trajectory performing the half-loop in 13.6 seconds. The agility induced by thrust vectoring capability provided a minimum effect on reducing the maneuver time. By means of thrust vectoring control the 90 degrees pitch-up maneuver can be executed in a small place over a short time interval. The agility capability of thrust vectoring is quite beneficial for pitch-up maneuvers. The level turn results are based currently on only outer layer solutions of singular pertrubation. Poststall solutions provide high turn rates but generate higher losses of energy than that of classical sustained solutions.

Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N91-18004# Wichita State Univ., KS. National Inst. for Aviation Research.
PROCEEDINGS: TECHFEST 17
Neal J. Pfeiffer, ed. (Beech Aircraft Corp., Wichita, KS.) 1991 39 p Conference held in Wichita, KS, 16-17 Nov. 1990; sponsored by AIAA and Wichita State Univ.
(NIAR-91-1) Avail: NTIS HC/MF A03

Papers presented at the Wichita Section of the American Institute of Aeronautics and Astronautics Techfest 17 are compiled. The following subject areas are covered: NASA research; certification and aging aircraft; structures and material studies; aviation safety; aerodynamics topics; and aircraft design and sport aviation. For individual titles, see N91-18005 through N91-18029.

N91-18005*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHALLENGES IN AERONAUTICAL RESEARCH FOR THE 1990'S Abstract Only
Bruce Holmes *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 1 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03 CSCL 01B

Three areas of the specific NASA aeronautical research are discussed: (1) advanced subsonic transport airplanes; (2) next generation high speed civil transport aircraft (SST's); and (3) next century hypersonic vehicles. The research planning reflects an awareness of and sensitivity to modern, stringent environmental constraints, changing marketplace demands, and advanced technology driven opportunities. The technical foundations of those future systems are described. Y.S.

N91-18006*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FUTURE REGIONAL/COMMUTER CHALLENGES Abstracts Only **c03**
W. Don Harvey *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 2 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03 CSCL 01C

Technological advances in the next ten years will represent a continuum of the steady improving state-of-the-art in all the major disciplines. In the past there was a number of step changes in technology, but no known really large quantum jumps are envisioned at present which could be readily applied to short haul aircraft. The one exception in the field of aerodynamics might be the application of natural laminar flow on short haul and laminar flow control on long haul aircraft. The aim in the 1990's will be to single out the major areas where advances will contribute to overcome important constraints such as fuel conservation, noise, airspace and airport saturation, and surface transportation competition. Y.S.

N91-18007*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DOPPLER GLOBAL VELOCIMETRY **c04**
Jim Usry *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 3-4 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03 CSCL 17G

A new program to develop a Doppler Global Velocimeter (DGV) for application in the High angle-of-Attack Technology Program is discussed. The Flight research instrument system will make non-intrusive multicomponent velocity measurements of the vortical flow field around an aircraft in flight. The DGV will provide a means to obtain airborne experimental data to evaluate and refine computational fluid dynamic models and to correlate with wind-tunnel data sets. The primary use of the instrument system will be to provide a flexible research tool to map the 3D velocity field at various locations around an aircraft during high angle-of-attack maneuvers at subsonic, transonic, and supersonic speeds. Other potential applications may include shock definition and interactions, external stores flow interactions, rotary flow field definition, non-steady flow field definition, measurement of inlet and duct flow field, and measurement of hypersonic flow field in flight. Y.S.

N91-18008# Beech Aircraft Corp., Wichita, KS. Technical Services Div.
AGING AIRCRAFT: ISSUES AND PARTIAL ANSWERS Abstract Only
Bill Schultz *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 5 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The spectrum of factors affecting the airplane aging process are reviewed. Discussion emphasis is given to airframe strength, durability and life to show the complex nature of several aging influencing factors. The status of industry and regular activities and plans are also presented. Y.S.

N91-18009# Wichita State Univ., KS. Dept. of Mechanical Engineering.
AUTOMATED INSPECTION SYSTEM FOR AGING AIRCRAFT Abstract Only
Behnam Bahr *In its* Proceedings: Techfest 17 1991 p 6 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The state-of-the-art automation techniques and the robotics developments for inspection of aircraft are reviewed. The advantages and disadvantages of different systems in terms of cost, ease of usage, required training, and portability are analyzed so that one can make an intelligent decision about selection of the appropriate system for the inspection process. These systems include the gantry system at the Air Logistic Center at the Air Force Base in Sacramento, California, the proposed fork-lift-type system by United Technologies and Lockheed, the Japanese car wash type approach, and other conventional six-degree of freedom robots. Author

N91-18010# Wichita State Univ., KS. Dept. of Mechanical Engineering.
FOUR-LEGGED SURFACE-CLIMBING ROBOT FOR THE INSPECTION OF AGING AIRCRAFT Abstract Only
Behnam Bahr and Sami Maari *In its* Proceedings: Techfest 17 1991 p 7 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The development of a small, spider-like robot which can carry a variety of nondestructive testing devices is discussed. This robot can be guided from the ground and its signals can be processed in a personal computer. The device can be used for inspection of

a wide variety of commercial aircrafts. Its size and cost permit inspection to be done in many locations along with regularly scheduled maintenance. This is a timely, cost-effective, reliable approach to a continuing problem of aging aircraft. Y.S.

N91-18011# Wichita State Univ., KS. Dept. of Mechanical Engineering.
NEURAL NETWORKS IN FLAW DETECTION Abstract Only **c38**
Behnam Bahr and Nabeel Tarabishy *In its* Proceedings: Techfest 17 1991 p 8 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Many non-destructive inspection methods such as vision system, ultrasonic, and eddy current may be used for flaw detection of aircraft structures. These method require a skilled technician to identify flaws. Human error was identified to be a major contributing factor in probability of detection of defects or false calls. A neural network and its usage for aiding the technician in detecting the defects are discussed. Author

N91-18012# Cessna Aircraft Co., Wichita, KS.
DESIGNING AIRCRAFT STRUCTURES FOR TOLERANCE TO FATIGUE DAMAGE Abstract Only **c05**
Robert B. Held and Dennis L. Longhofer *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 8 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The airframes of the general aviation fleet evolved through static strength-fatigue strength-fail safe strength design criteria. Designing for tolerance to fatigue damage became a significant part of the design philosophy. Structural fatigue began to play a larger role in the airframe design with the desire for lighter weight structure, improved performance, higher operational weight, and increased usage. The design evolution moved into the phase where the principles of fracture mechanics have become a tool to set economic service lives and airframe inspection periods. The history in fatigue design, fleet history, the impact of fracture mechanics on the fleet aircraft and future designs are discussed. Author

N91-18013# Cessna Aircraft Co., Wichita, KS.
AIRFRAME CORROSION Abstract Only **c05**
L. Ayala *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 9 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Aircraft concerns have provided the need to focus on problems associated with airframe exposure to operating usage and environmental conditions. These concerns were traditionally addressed in the airframe design. Emphasis on aging aircraft has resulted in renewed interest to provide protection against environmental conditions that enhance corrosion activity. Common causes of airframe corrosion, specific examples, treatment and rework of damaged areas are discussed. A brief discussion of industry activities on corrosion issues is included. Author

N91-18014# Wichita State Univ., KS. Dept. of Aerospace Engineering.
ENVIRONMENTAL EFFECTS ON DELAMINATION OF GRAPHITE EPOXY COMPOSITES **c24**
Steve Hooper *In its* Proceedings: Techfest 17 1991 p 9-13 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Delamination is a significant, and frequently the critical, failure mode in advanced composite materials. Delaminations are important considerations in the design of composite structures since their presence results in reduced laminate stiffness, strength, and fatigue life. The development of free-edge delamination is generally attributed to the existence of singularities near the interfaces of the laminae in the region of a free edge. For the case of mechanical loading, the stress concentrations develop due to the mismatch in Poisson's ratio between the adjacent plies. For the case of thermal or hygroscopic loading, the singularities are developed as a result of the mismatch in the coefficients of thermal and/or hygroscopic expansion, as well as the mismatch in Poisson's ratio. The question of how a nonuniform moisture distribution affects delamination onset is studied. Tests were conducted on different laminates designs which were exposed to different types of fluids, such as water and jet fuels. The effects of a nonuniform moisture distribution on the total and mixed-mode strain energy release rates were analyzed using a modified theory analysis and a quasi-3D finite element method respectively. Both analyses employed a Fickian moisture diffusion model. Author

N91-18015# Wichita State Univ., KS. Dept. of Mechanical Engineering.
USE OF NATURAL PARTICLES FOR THE REMOVAL OF PAINT FROM AERONAUTICAL COMPOSITE MATERIALS Abstract Only **c31**
Thu-Ha Guy, Hamid M. Lankarani, and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 14 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Paint removal by blasting and its effects on the surface morphology of aeronautical composite materials are investigated. An ideal combination of the parameters for mechanical paint removal by blasting such as particle type, size, velocity and angle of incidence yields a stripped aircraft skin substrate with minimal or no damage. Natural particles, specifically white corn flour, seem to be a good choice for paint removal by blasting. Since they are softer as well as smaller in size than other particles used for paint removal, they minimize the amount of damage to the surface of the composite. They are also cheaper and produce no harm to environment. The variation of the degree of surface roughness and the amount of broken fibers were correlated with some stripping parameters, such as particle impact angle and velocity. This defined an optimum environment for paint removal by blasting. Author

N91-18016# Wichita State Univ., KS. Dept. of Mechanical Engineering.
ANALYSIS OF RESIDUAL STRESS IN PLASTIC-MEDIA-BLASTED THIN ALUMINUM SKIN BY X-RAY DOUBLE CRYSTAL DIFFRACTOMETRY Abstract Only **c39**
J. Chaudhuri, Y. M. Tan, and K. Patni (Cessna Aircraft Co., Wichita, KS.) *In its* Proceedings: Techfest 17 1991 p 15 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Plastic media blasting technique, also frequently called dry stripping, refers to the use of light weight lightly abrasive plastic grit to remove coatings by a combination of cutting and chipping actions. The x-ray double crystal diffractometry technique was used to measure residual stresses in plastic media blasted 0.032 in. thick Alclad 2024 aluminum sheet material, which is representative of the fuselage skin of most Cessna aircraft models. Among the blasting parameters, the velocity, angle-of-attack, and distance were varied in order to determine an optimum blasting condition. Author

N91-18017# Wichita State Univ., KS. Dept. of Mechanical Engineering.
EFFECTS OF INDUCED SURFACE SCRATCHES ON THE FATIGUE OF AERONAUTICAL MATERIALS Abstract Only **c39**
A. Inchekel and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 16 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The effects of surface scratches on the fatigue behavior of aluminum alloy subjected to a tension-tension fatigue cycling are investigated. The parameters defining the scratches and their influences on the number of cycles to failure, crack nucleation, and propagation are evaluated. Relevant information on the determination of the relationship of the parameters and the fatigue life with the module of failure is identified by using SEM fractographs. This micro analysis is used to recognize the failure mechanisms of aluminum alloys. Author

N91-18018# Wichita State Univ., KS. Dept. of Mechanical Engineering.
STUDY OF THE AGING AND DEFORMATION CHARACTERISTICS OF Al-Li ALLOYS BY X-RAY ANALYSIS Abstract Only **c26**
V. Gondhalekar, A. Inchekel, J. Chaudhuri, and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 17 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

A non-destructive x-ray rocking curve technique, the double crystal diffractometer method, is used to investigate aging and deformation characteristics of Al-Li alloys. The method is extremely sensitive to measure strain and dislocation densities. X-ray analysis was used to correlate the different stages of microstructure during aging and deformation. Models were also developed to describe the microstructure behavior of these alloys. Author

N91-18019# Wichita State Univ., KS. Dept. of Mechanical Engineering.
ASSESSMENT OF MATERIAL PARAMETERS GOVERNING THE PLASTIC DEFORMATION IN UNIAXIAL TENSION OF Al-Li ALLOYS Abstract Only **c26**
A. Inchekel and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 18 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The effects of the plastic deformation parameters on the stretch formability of Al-Li 2090 alloy were studied on gridded and ungridded samples. These specimens were pulled under tension to failure. Such tests are important in evaluating the mechanical properties of the material and the influence of the strain hardening and the strain rate hardening on the material deformation. The strain distributions on the grids were analyzed and the deformations registered to account for the formation of a diffuse neck and/or local neck. Furthermore, SEM was used on the fractured samples to correlate the results to the microstructure of the material. Author

N91-18020# Wichita State Univ., KS. National Inst. for Aviation Research.
AVIATION SAFETY ENHANCEMENTS THROUGH THE INTERNATIONAL AIRCRAFT DATABASE RESEARCH PROJECT Abstract Only **c03**
John Hutchinson and Brent Bowen *In its* Proceedings: Techfest 17 1991 p 19 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Aircraft operational safety is dependent upon the prompt distribution of airworthiness directives issued by the Federal Aviation Administration (FAA). It is very important to enhance the timely distribution of airworthiness information to the operators of U.S. registered aircraft. To facilitate this, a prototype system is under development which will track, identify, and retrieve civil aircraft information on both a domestic and international basis. The final result will be the delivery of a turn-key system to the FAA. This system will comply with FAA requirements for data management as well as incorporate a user-friendly, automated, menu driven filing and retrieval system. Author

N91-18021# Wichita State Univ., KS. Dept. of Mechanical Engineering.
COMPUTER SIMULATIONS OF AN AIRCRAFT OCCUPANT-RESTRAINT SYSTEM Abstract Only **c03**
Deren Ma and Hamid M. Lankarani *In its* Proceedings: Techfest 17 1991 p 20 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

A multi-segment model of the human body, the seat, the restraint system, and a computer environment are presented to simulate the post-crash response of the occupant in the specific types of surges such as frontal or rear collisions. The human body is modeled as a collection of elements interconnected by an array of kinematic joints constraining the relative motion of the elements. The model includes head-neck, upper body, upperarms, forearms, thighs, and lower legs. Nonlinear torsional spring-dampers are incorporated at the joints mimicking the anatomical characteristics and limits. To perform a dynamic analysis, a three-dimensional code is developed that generates and numerically solves the governing differential equations of motion in a systematic fashion. Simple graphical images of the system are obtained from a post-processing program. This computerized model and the results of the simulations provide means for predicting motion response and possible injuries of crash victims with much less effort and more data, but consistent with the results of anthropomorphic dummies. Author

N91-18022# Wichita State Univ., KS. National Inst. for Aviation Research.
AN OVERVIEW OF INFORMATION RESOURCES IN AVIATION Abstract Only **c82**
Thomas G. DePetro *In its* Proceedings: Techfest 17 1991 p 21 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Information resources in aviation are produced by many organizations, including publishing companies, government agencies, professional associations, research institutes, and colleges and universities. Topics in aviation include management, government regulation, air transport, engineering, technology, research and development, and applied sciences. Information is available in a number of formats including books, periodicals, maps, charts, government documents, technical reports, professional papers, microfiche, and, more recently, audio and video cassette tapes and CD-ROM and on-line computer databases. Author

N91-18023# Wichita State Univ., KS. National Inst. for Aviation Research.
EXPERIMENTAL STUDIES OF GENERAL AVIATION WINGS AT HIGH ANGLES OF ATTACK Progress Report Abstract Only **c05**
Melvin H. Snyder *In its* Proceedings: Techfest 17 1991 p 22 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Work continues on the projects of developing general aviation wings which can be laterally controlled into and through the stall. In 1989 a paper was presented which suggested that lateral control of a wing, and possibly additional lift at angles of attack above stall, could be obtained by use of hinged control surfaces at the leading-edge near the wing tips. This idea was pursued using a flow visualization model in the water tunnel and a reflection plane wind tunnel model. Both models used a modified NFL airfoil section and leading-edge and trailing-edge ailerons. The wind tunnel tests included both force and pressure distribution tests. A summary of these results is presented as well as outline of wing tip surveys currently going on in the water tunnels. Author

N91-18024# Wichita State Univ., KS. Dept. of Mechanical Engineering.
MODELING HIGH ANGLE-OF-ATTACK FORCES AND MOMENTS USING A NEURAL NETWORK Abstract Only **c05**
James E. Steck and Kamran Rokhsaz (Missouri Univ., Rolla.) *In its* Proceedings: Techfest 17 1991 p 23 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The current interest in super-maneuverable aircraft, which achieve angle of attack excursions of greater than 90 deg, has generated a need for modeling force and moment behavior at these high angles of attack. The force and moment coefficients are highly nonlinear functions of the angle of attack time histories. An appropriately constructed artificial neural network can be used as a discrete model of a highly nonlinear continuous time system. A network is 'trained' to predict the force and moment coefficients of a 70 deg sweep delta wing during a sinusoidal angle of attack time history from 0 to 90 deg and returning to 0 deg. Experimental data for reduced frequencies of 0.0, 0.01, 0.03, and 0.04 are presented to the network. The network is trained so that it models these frequencies with sufficient accuracy. The network is then used to independently predict the force and moment coefficients

for an intermediate reduced frequency of 0.02. These predictions are favorably compared to experimental data for this reduced frequency. Author

N91-18025# Wichita State Univ., KS. Dept. of Aerospace Engineering.
COMPUTATIONAL FLUID DYNAMICS IN AEROSPACE ENGINEERING AT WICHITA STATE UNIVERSITY Abstract Only **c34**
Steve Klausmeyer, S. Reddy, X. Lui, and M. Papadakis *In its* Proceedings: Techfest 17 1991 p 24 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

A summary of recent research performed in the department of Aerospace Engineering of the Wichita State University in the field of Computational Fluid Dynamics is presented. Computer codes developed and solutions obtained for a variety of flow conditions are also presented. The following subject areas are covered: steady and unsteady free and impinging 2D jet flows; viscous and inviscid solutions for airfoils at subsonic, transonic, and supersonic speeds; the shock wave interaction evaluation for a complex geometry in hypersonic flow; and 3D flow about a delta wing. Y.S.

N91-18026# Wichita State Univ., KS. Dept. of Mechanical Engineering.
EXPERIMENTAL STUDY OF INLET LIPS DESIGNED TO CREATE A UNIFORM EXIT VELOCITY PROFILE Abstract Only **c05**
Paul O. Steranka, Jr. and Abdul S. Tohmaz *In its* Proceedings: Techfest 17 1991 p 25 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

An experimental study was conducted in order to evaluate a set of inlet lips designed and fabricated for use in the internal aerodynamic test facility. The inlet lips were designed to create a uniform velocity at the entrance to test ducts studied in parallel computational and experimental investigations of flow through ducts with offset and diffusion, which can often be found in aircraft engine inlets. The fabrication and experimental study of the inlet tips is presented. Laser Doppler anemometry was used to make non-intrusive measurements of the velocity profiles at several stations for comparison with the predicted profiles from the design calculations. The experimental results show the inlet lips perform as designed. Author

N91-18027# Wichita State Univ., KS. Dept. of Mechanical Engineering.
LDV MEASUREMENTS OF A JET IN A CROSSFLOW Abstract Only **c34**
Julie A. Mathis *In its* Proceedings: Techfest 17 1991 p 26 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

Measurements of the flow field created by a jet exhausting into a wind tunnel crossflow are obtained with laser Doppler velocimetry (LDV) techniques. Results are summarized and compared with predictions of a computational model, and the limitations of computational fluid dynamics as applied to turbulent flow fields are discussed. Analysis of the velocity time evolution data collected provides information on the turbulent microstructure of the flow. The fractal dimension of the microstructures is estimated, and its relevance is discussed. Author

N91-18028# Kansas Univ., Lawrence. Dept. of Aerospace Engineering.
ON THE FEASIBILITY OF SMALL, VERY-LONG-RANGE CIVIL TRANSPORTS Abstract Only **c03**
Jan Roskam *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 26 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The technical and economical feasibility of developing a 150 passenger 6000 nm range civil transport is discussed. Such a transport could connect a large number of city pairs which cannot be economically serviced by existing, much larger wide body jet transports. It is shown which combinations of aerodynamic, propulsive, and structural technologies will allow such a transport to be developed such that it can compete on a cost-per-seat-mile basis with todays wide body jets. Author

N91-18029# Merkel Aircraft Co., Wichita, KS.
SPORT AVIATION AND SAFETY Abstract Only **c03**
Edwin Merkel *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 27 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

The Sport Aviation Manufacturers Association is seeking to develop and secure appropriate modifications in the FAR certification rules and airworthiness standards. The primary emphasis must be safety of flight, which must start with handling qualities. Handling qualities must start with the spin phenomena, since aircraft accident history reveals the spin to be the greatest source of general aviation accidents. Y.S.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N91-18030*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DETAILED FLOW-FIELD MEASUREMENTS OVER A 75 DEG SWEPT DELTA WING
Scott O. Kjelgaard and William L. Sellers, III Washington Oct. 1990 45 p Original contains color illustrations
(NASA-TP-2997; L-16718; NAS 1.60:2997) Avail: NTIS HC/MF A03; 16 functional color pages CSCL 01A

Results from an experimental investigation documenting the flowfield over a 75 deg swept delta wing at an angle-of-attack of 20.5 deg are presented. Results obtained include surface flow visualization, off-body flow visualization, and detailed flowfield surveys for various Reynolds numbers. Flowfield surveys at Reynolds numbers of 0.5, 1.0, and 1.5 million based on the root chord were conducted with both a Pitot pressure probe and a 5-hole pressure probe; and 3-component laser velocimeter surveys were conducted at a Reynolds number of 1.0 million. The Pitot pressure surveys were obtained at 5 chordwise stations, the 5-hole probe surveys were obtained at 3 chordwise stations and the laser velocimeter surveys were obtained at one station. The results confirm the classical roll up of the flow into a pair of primary vortices over the delta wing. The velocity measurements indicate that Reynolds number has little effect on the global structure of the flowfield for the Reynolds number range investigated. Measurements of the non-dimensional axial velocity in the core of the vortex indicate a jet like flow with values greater than twice freestream. Comparisons between velocity measurements from the 5-hole pressure probe and the laser velocimeter indicate that the pressure probe does a reasonable job of measuring the flowfield quantities where the velocity gradients in the flowfield are low. Author

N91-18031*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PHYSICALLY WEIGHTED APPROXIMATIONS OF UNSTEADY AERODYNAMIC FORCES USING THE MINIMUM-STATE METHOD
Mordechay Karpel (Technion - Israel Inst. of Tech., Haifa.) and Sherwood Tiffany Hoadley Washington Mar. 1991 46 p
(NASA-TP-3025; L-16491; NAS 1.60:3025) Avail: NTIS HC/MF A03 CSCL 01A

The Minimum-State Method for rational approximation of unsteady aerodynamic force coefficient matrices, modified to allow physical weighting of the tabulated aerodynamic data, is presented. The approximation formula and the associated time-domain, state-space, open-loop equations of motion are given, and the

numerical procedure for calculating the approximation matrices, with weighted data and with various equality constraints are described. Two data weighting options are presented. The first weighting is for normalizing the aerodynamic data to maximum unit value of each aerodynamic coefficient. The second weighting is one in which each tabulated coefficient, at each reduced frequency value, is weighted according to the effect of an incremental error of this coefficient on aeroelastic characteristics of the system. This weighting yields a better fit of the more important terms, at the expense of less important ones. The resulting approximate yields a relatively low number of aerodynamic lag states in the subsequent state-space model. The formulation forms the basis of the MIST computer program which is written in FORTRAN for use on the MicroVAX computer and interfaces with NASA's Interaction of Structures, Aerodynamics and Controls (ISAC) computer program. The program structure, capabilities and interfaces are outlined in the appendices, and a numerical example which utilizes Rockwell's Active Flexible Wing (AFW) model is given and discussed. Author

N91-18032*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EXPLICIT UPWIND ALGORITHM FOR SOLVING THE PARABOLIZED NAVIER-STOKES EQUATIONS
John J. Korte Washington Feb. 1991 71 p Original contains color illustrations
(NASA-TP-3050; L-16753; NAS 1.60:3050) Avail: NTIS HC/MF A04; 1 functional color page CSCL 01A

An explicit, upwind algorithm was developed for the direct (noniterative) integration of the 3-D Parabolized Navier-Stokes (PNS) equations in a generalized coordinate system. The new algorithm uses upwind approximations of the numerical fluxes for the pressure and convection terms obtained by combining flux difference splittings (FDS) formed from the solution of an approximate Riemann (RP). The approximate RP is solved using an extension of the method developed by Roe for steady supersonic flow of an ideal gas. Roe's method is extended for use with the 3-D PNS equations expressed in generalized coordinates and to include Vigneron's technique of splitting the streamwise pressure gradient. The difficulty associated with applying Roe's scheme in the subsonic region is overcome. The second-order upwind differencing of the flux derivatives are obtained by adding FDS to either an original forward or backward differencing of the flux derivative. This approach is used to modify an explicit MacCormack differencing scheme into an upwind differencing scheme. The second order upwind flux approximations, applied with flux limiters, provide a method for numerically capturing shocks without the need for additional artificial damping terms which require adjustment by the user. In addition, a cubic equation is derived for determining Vegneron's pressure splitting coefficient using the updated streamwise flux vector. Decoding the streamwise flux vector with the updated value of Vigneron's pressure splitting improves the stability of the scheme. The new algorithm is applied to 2-D and 3-D supersonic and hypersonic laminar flow test cases. Results are presented for the experimental studies of Holden and of Tracy. In addition, a flow field solution is presented for a generic hypersonic aircraft at a Mach number of 24.5 and angle of attack of 1 degree. The computed results compare well to both experimental data and numerical results from other algorithms. Computational times required for the upwind PNS code are approximately equal to an explicit PNS MacCormack's code and existing implicit PNS solvers. Author

N91-18033*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LOW-SPEED WIND-TUNNEL TEST OF AN UNPOWERED HIGH-SPEED STOPPABLE ROTOR CONCEPT IN FIXED-WING MODE
Michael B. Lance, Daniel Y. Sung, and Robert H. Stroub (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) Washington Mar. 1991 53 p
(NASA-TM-4250; L-16716; NAS 1.15:4250) Avail: NTIS HC/MF A04 CSCL 01A

An experimental investigation of the M85, a High Speed Rotor Concept, was conducted at the NASA Langley 14 x 22 foot Subsonic Tunnel, assisted by NASA-Ames. An unpowered 1/5 scale model of the XH-59A helicopter fuselage with a large circular hub fairing, two rotor blades, and a shaft fairing was used as a baseline configuration. The M85 is a rotor wing hybrid aircraft design, and the model was tested with the rotor blade in the fixed wing mode. Assessments were made of the aerodynamic characteristics of various model rotor configurations. Variation in configurations were produced by changing the rotor blade sweep angle and the blade chord length. The most favorable M85 configuration tested included wide chord blades at 0 deg sweep, and it attained a system lift to drag ratio of 8.4. Author

N91-18034# Duke Univ., Durham, NC. School of Engineering.
PROCEEDINGS OF THE 3RD WORKSHOP ON DYNAMICS AND AEROELASTIC STABILITY MODELING OF ROTORCRAFT SYSTEMS Final Report, 1 May 1989 - 30 Jun. 1990
Earl H. Dowell 14 Mar. 1990 239 p Workshop held in Durham, NC, 12-14 Mar. 1990 Sponsored in part by Duke Univ.
(Grant DAAL03-89-G-0023)
(AD-A227930; ARO-26466.1-EG-CF) Avail: NTIS HC/MF A11 CSCL 01/3

The workshop was held as scheduled. Sessions included rotorcraft dynamics research, physical modeling, rotorcraft centers of excellence, aeroelasticity and stability, response dynamics and control, mathematics of modeling, and experimental-theoretical investigations. GRA

N91-18035# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
SPECIAL COURSE ON INVERSE METHODS FOR AIRFOIL DESIGN FOR AERONAUTICAL AND TURBOMACHINERY APPLICATIONS
Nov. 1990 259 p Course held in Rhode-Saint-Genese, Belgium, 14-18 May 1990; sponsored by AGARD and the von Karman Inst.
(AGARD-R-780; ISBN-92-835-0591-3) Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Three major aspects of airfoil design are examined both for aeronautical and turbomachine application. Optimization of target pressure distribution and velocity distribution are studied. Both direct optimization resulting from an inverse boundary layer calculation and an iterative optimization of the losses are presented. Airfoil design by means of inverse methods is also studied. This ranges from simple parametric definitions of 2-D cross sections to a detailed numerical definition of 3-D shapes. The methodology to account for a large number of constraints and off-design operation is also discussed and illustrated by a large number of applications. For individual titles, see N91-18036 through N91-18047.

N91-18036# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
AERODYNAMIC SHAPE DESIGN
George S. Dulikravich *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 10 p (For primary document see N91-18035 10-02)
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Design of aerodynamic shapes can be accomplished by using the methodologies from computational fluid dynamics and optimization. Two basic categories of the inverse (design) formulations are surface flow design and flow field design. A number of methods in both categories are discussed and critically evaluated. Open questions remain to be specified of a more appropriate surface pressure, acceleration of iterative algorithms, increased versatility of the design methods, direct use of the existing and future flow field analysis software. Author

N91-18037# National Technical Univ., Athens (Greece). Thermal Turbomachinery Lab.
ARBITRARY BLADE SECTION DESIGN BASED ON VISCOUS CONSIDERATIONS
K. D. Papailiou and B. Bouras *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 53 p (For primary document see N91-18035 10-02)
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Theoretical tools are proposed that may help the designer in aerodynamic design. In fact, a complete (viscous and inviscid) inverse procedure is proposed, but, it is pointed out that in order to obtain results, it has to be combined with a sound direct (analysis) one. Various examples are chosen in order to demonstrate the use of the proposed tools. These examples do not cover all cases, but rather converge to the conclusion that the proposed tools may prove to be quite useful, while, each design must be considered as a separate case. Author

N91-18038# National Aerospace Lab., Amsterdam (Netherlands).
OPTIMIZATION OF TARGET PRESSURE DISTRIBUTIONS
R. F. vandenDam, J. A. vanEgmond, and J. W. Slooff *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 13 p (For primary document see N91-18035 10-02)
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An overview is presented of the possibilities and problems associated with the use of numerical optimization techniques in aerodynamic design. First, an inventory is made of the alternative aerodynamic design methods, the numerical optimization approach being one of them. The development of optimizing design methods is outlined and a short exposition of the state of the art in numerical optimization is given. This is followed by a discussion on the practical use of numerical optimization techniques in aerodynamic design, in particular the inverse numerical optimization approach. An important step in this approach is the optimization of target pressure distributions, which are used by inverse methods to find the corresponding geometry. The procedure for finding target pressure distributions is explained and illustrated by some examples. Author

N91-18039# Grumman Aerospace Corp., Bethpage, NY.
GEOMETRIC AND SURFACE PRESSURE RESTRICTIONS IN AIRFOIL DESIGN
G. Volpe *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 14 p (For primary document see N91-18035 10-02)
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In order to design a physically acceptable airfoil that corresponds to a prescribed surface pressure or speed distribution, various restrictions have to be met by the imposed target and by the contour. It is shown that the need to meet geometric prerequisites and a specified free stream value imposes constraints on the prescribed surface values which, unless satisfied, inhibit the existence of a solution. In this classical problem of airfoil design, the prescribed surface distribution must contain enough degrees of freedom in order that it may be modified sufficiently to satisfy the contraints. The nature of the constaints is discussed, and they are expressed in forms which are amenable to numerical solution procedures in transonic as well as incompressible flows. THe discussion is accompanied by a description of the general characteristics of airfoil geometries and surface flows. Author

N91-18040# Grumman Aerospace Corp., Bethpage, NY.
TRANSONIC SHOCK FREE WING DESIGN
G. Volpe *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 16 p (For primary document see N91-18035 10-02)
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The problem of constructing wing profiles that yield specified pressure distributions and/or performance characteristics is discussed. A practical solution to the problem, which consists of a physically acceptable profile, exists only if certain constraints are satisfied by the prescribed characteristics and by the profile itself. These constraints are addressed in various manners by the several methodologies that are proposed. The various approaches are discussed along with the relative advantages and disadvantages of each. The inverse approach is considered in detail to provide a link to the classical incompressible design problem and to establish a raison d'etre for the other methodologies. Author

N91-18041# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
A STREAM-FUNCTION-COORDINATE (SFC) CONCEPT IN AERODYNAMIC SHAPE DESIGN
George S. Dulikravich *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 6 p (For primary document see N91-18035 10-02)
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A new approach to the inverse design of 2-D aerodynamic shape was developed. This formulation is based on a Stream Function Coordinate (SFC) concept for steady, irrotational, compressible, inviscid, planar flows. It differs from the classical stream function formulation in that it treats the y coordinate of each point on a streamline as a function of the x coordinate and the stream function psi, i.e., Y = Y(x,psi). This new formulation is especially suitable for the computation of stream line shapes, and therefore, for determination of aerodynamic shapes subject to specified surface pressure distributions. An additional advantage of this new formulation is that it requires the generation of only a 1-D grid in the x direction. The grid in the y direction is computed as a part of the solution since y coordinates of the streamlines are treated as the unknowns in the SFC formulation. In addition, the SFC method is equally suitable for the analysis of the flow fields around given shapes. A computer code was developed on the basis of SFC formulation. It is capable of performing flow field analysis and inverse design of airfoil cascade shapes by changing a single input parameter. Author

N91-18042# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
SUBSONIC AND TRANSONIC CASCADE DESIGN
Olivier Leonard *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 18 p (For primary document see N91-18035 10-02)
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Two iterative methods for blade design, using direct flow solvers and a blade geometry change algorithm, are presented. Both procedures start with the analysis of a given cascade geometry using an existing flow solver. The difference between the calculated velocity distribution and the required one is used to calculate a flow distortion. In the first method, this flow distortion is produced by singularities while in the second method the distortion is derived by imposing the required velocity distribution as a boundary condition. This flow distortion is used by the modification algorithm and results in a new blade shape for which the calculated velocity is closer to the desired one. Examples for both subsonic and transonic flows are presented and show a rapid convergence to the geometry required for the desired velocity distribution. The main advantage of the proposed method is that existing analysis codes can be used, for the design and for the off-design analysis. Some restrictions which have to be imposed on the required velocity distributions are also discussed. Author

N91-18043# Politecnico di Torino (Italy).
INVERSE METHODS FOR 3D INTERNAL FLOWS
Luca Zannetti and Francesco Larocca (Fiat Aviazione S.p.A., Turin, Italy) *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 16 p (For primary document see N91-18035 10-02)
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The objective was a numerical method for designing 3-D ducts and blade rows. The method applies to inviscid compressible rotational flow, and it is based on the time dependent technique. The walls where the design pressure is prescribed are considered as flexible and impermeable. Starting from some initial guessed configuration, the computation follows the transient which occurs while the flexible walls move and finally reach a steady shape. Author

N91-18044# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
VISCOUS AND INVISCID INVERSE SCHEMES USING NEWTON'S METHOD
Mark Drela *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 16 p (For primary document see N91-18035 10-02)
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Developments in design analysis methodology for airfoils and cascades are presented. Shortcomings of standard inverse methods in flows involving shock waves are overcome by a modal geometry perturbation inverse method driven by a least squares pressure mismatch minimization. The method is incorporated into an existing viscous inviscid zonal method. Simultaneous solution of the flow field equations and the pressure mismatch minimization equations is obtained by a full Newton method. This leads to very large computational savings compared to traditional minimization methods. The method is also applicable to viscous flows with or without separation regions present. The Newton based solution scheme, which yields sensitivity information as a by-product, also allows very efficient solution of general optimization problems. Perturbation of the geometry and flow field is specified outside of the Newton solver so as to drive any aerodynamic and/or geometric quantity to its minimum. The availability of free sensitivity information and the rapid reconvergence property of the Newton method after each optimization cycle again gives very large computational savings. Author

N91-18045# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dept. of Aerodynamics.
ONE POINT AND MULTI-POINT DESIGN OPTIMIZATION FOR AIRPLANE AND HELICOPTER APPLICATION
J. J. Thibert *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 47 p (For primary document see N91-18035 10-02)
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Numerical optimization techniques are described and the use is shown as to how these techniques can be used. Emphasis is put on the applications with various optimization cases described in details. One point optimization cases for airfoil and wing designs with different objective functions, constraints and design variables are presented as well as multiple design point cases for helicopter blade airfoil applications. Author

N91-18046# National Aerospace Lab., Amsterdam (Netherlands).
CONSTRAINED SPANLOAD OPTIMIZATION FOR MINIMUM DRAG OF MULTI-LIFTING-SURFACE CONFIGURATIONS
R. F. vandenDam *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 15 p (For primary document see N91-18035 10-02)
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A method is presented for the determination of optimal spanloads for multi lifting surface configurations. Algorithms are given for choosing the spanwise distributions of lift, pitching moment, chord and thickness to chord ratio of lifting elements. The choices are optimal in that they minimize induced plus viscous drag while satisfying constraints of aerodynamic, flight mechanical, and structural nature. The configuration that can be dealt with, may consist of a number of segments representing, for instance, wings or parts of wings, horizontal tails or canards, winglets, flap rail fairings, etc. Also the interaction between propellers and lifting elements may be included in the procedure. The induced drag is computed using the Trefftz plane integral, while the viscous drag follows from form factor methods. Novel mathematical formulations of the constrained optimization problem are used, that are based on the calculus of variations. The method can be used as a first step in the inverse numerical optimization approach to provide a starting point for the specification of target pressure distributions. Theoretical models and methods underlying the analysis and optimization are presented. Author

N91-18047# Sverdrup Technology, Inc., Eglin AFB, FL.
AERODYNAMIC OPTIMIZATION BY SIMULTANEOUSLY UPDATING FLOW VARIABLES AND DESIGN PARAMETERS
M. H. Rizk *In* AGARD, Special Course on Inverse Methods for Airfoil Design for Aeronautical and Turbomachinery Applications Nov. 1990 22 p Previously announced as N90-20991 (For primary document see N91-18035 10-02)
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The application of conventional optimization schemes to aerodynamic design problems leads to inner-outer iterative procedures that are very costly. An alternative approach is presented based on the idea of updating the flow variable iterative solutions and the design parameter iterative solution simultaneously. Two schemes based on this idea are applied to problems of correcting wind tunnel wall interference and optimizing advanced propeller designs. Computations are performed to test the schemes' efficiency, accuracy, and sensitivity to variations in the computational parameters. Author

N91-18048# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
AERODYNAMICS OF ROTORCRAFT
Nov. 1990 307 p Special course held in Rhode-Saint Genese, Belgium, 2-5 Apr. 1990, in Ankara, Turkey, 9-11 Apr. 1990, and at Moffett Field, CA, 14-17 May 1990; sponsored by AGARD and the von Karman Inst.
(AGARD-R-781; ISBN-92-835-0592-1) Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The course first summarizes the various configurations of different rotary-wing aircraft and the simple methods to calculate their performance. Methods for designing efficient rotors are explained and justified. The optimization codes for airfoil and blade determinations are described. The rotor design can be improved by using advanced three dimensional aerodynamic codes, whose actual possibilities are presented. The consequences of specific aerodynamic phenomena are examined such as rotor wake on blade airloads and on rotor noise prediction. The state of the art of fuselage aerodynamics and on the problems related to rotor wake and fuselage interactions is given. An important part of the course is devoted to the experimental methods used for wind-tunnel and flight tests, in order to understand correctly the physical phenomena involved, and to acquire reliable data necessary for code validation. For individual titles, see N91-18049 through N91-18058.

N91-18049# Sikorsky Aircraft, Stratford, CT. Research and Advanced Design Div.
OVERVIEW OF HELICOPTER AND V/STOL AIRCRAFT

Evan A. Fradenburgh *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 18 p (For primary document see N91-18048 10-02)

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The development and history of the helicopter are briefly reviewed. Fundamental mechanisms of the helicopter are then described. The addition of auxiliary propulsion to a winged helicopter eliminates the restriction to normal speed. Rotorcraft configuration for high speed performance is examined. V/STOL concepts and economic impact are discussed. The roles of system complexity and reliability are discussed with an emphasis on cost effectiveness. The relationship of technical aerodynamics is examined against a background of other aspects of rotorcraft. B.G.

N91-18050# Sikorsky Aircraft, Stratford, CT. Research and Advanced Design Div.

BASIC AERODYNAMICS FOR ROTOR PERFORMANCE

Evan A. Fradenburgh *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 12 p (For primary document see N91-18048 10-02)

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Basic physics fundamental to helicopter flight; rotor and propeller performance in axial flight; hover performance; helicopter power requirements for forward flight; autorotation; ground effect and vertical drag effect; blade element theories; use of dimensionless coefficients for helicopter performance; and rotor lift drag ratio as a measure of aerodynamic efficiency are briefly discussed. B.G.

N91-18051# Aerospatiale, Marignane (France). Helicopter Div.

ROTOR AND BLADE AERODYNAMIC DESIGN

A. Vuillet *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 59 p (For primary document see N91-18048 10-02)

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This course is mainly related to the main rotor while the tail rotor and fenestron design are also discussed. The rotor is one of the helicopter's most specific component and plays a significant role as far as performance is concerned. The objective is to describe methods and give effective results that are useful in the design of a helicopter. The rotor's general sizing is discussed first. Studying engine failures and performance in autorotation as well as the power required in hover usually determines the rotor diameter; peripheral speed is selected in accordance with noise criteria; and the chord is dependent on the target maximum speed and load factor. The selection of the number of blades is more difficult and decided according to the vibration level transmitted at the airframe or noise rather than aerodynamic criteria. The rotor calculation methods, i.e., blade balance energy, blade element theory, and vortex theory are then described with a judgment as to their efficiency. The numerical optimization techniques are presented with their advantages by giving application examples on the selection of airfoil distribution spanwise. Fine optimization of the blade itself where the evolution of the airfoil design methods is explained with OA airfoils as an example is presented. The results obtained with blade planforms and tip shapes are largely discussed and two contradictory trends, i.e., blade tapering and enlarged tip as on WHL's BERP blade are presented. The influence of the anhedral and twist optimization are discussed. Tail rotor and fenestron designs are discussed. Author

N91-18052# Westland Helicopters Ltd., Yeovil (England). Dept. of Aerodynamics.

FUSELAGE AERODYNAMIC DESIGN ISSUES AND ROTOR/FUSELAGE INTERACTIONAL AERODYNAMICS. PART 1: PRACTICAL DESIGN ISSUES

F. T. Wilson *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 16 p (For primary document see N91-18048 10-02)

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The more important helicopter fuselage aerodynamic design issues and also interactional problems faced by the helicopter airframe aerodynamicist, including performance and handling optimization and special effects caused by rotor downwash impingement on the fuselage at low and high speeds are addressed. The experimental approach remains the principal tool for the solution of helicopter fuselage aerodynamic problems since existing theoretical methods still possess deficiencies such as an inability to model strong three dimensional effects and separated flow areas both on the fuselage and aft of the rotor head. Flight testing is not generally used for helicopter fuselage aerodynamic research work and the use of small scale wind tunnel models remains the principal experimental tool for airframe design. However, CFD methods are being increasingly used to supplement wind tunnel testing and research programs are underway to constantly improve and update techniques in both fuselage and rotor/fuselage interactional aerodynamics. Author

N91-18053# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).

FUSELAGE AERODYNAMICS DESIGN ISSUES AND ROTOR/FUSELAGE INTERACTIONAL AERODYNAMICS. PART 2: THEORETICAL METHODS

S. R. Ahmed *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 38 p (For primary document see N91-18048 10-02)

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Theoretical methods currently available to predict helicopter fuselage flow and interaction phenomena are reviewed. In view of the enormous challenge a helicopter flow field poses for CFD, only inviscid flow codes with subsequent viscous corrections have found applications in industry. The basic modules of such methods to treat the isolated fuselage flow are explained and the predictions compared with experimental data. Also newer developments, to devise codes based on time-averaged or time-dependent Navier-Stokes equations are discussed and their present capabilities indicated. Interaction phenomena remains for the foreseeable future beyond the possibilities of present viscous flow codes. Status and development trends of inviscid codes to simulate rotor/body/wake interaction phenomena is discussed and evaluated. Author

N91-18054*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE APPLICATION OF CFD TO ROTARY WING FLOW PROBLEMS

F. X. Caradonna (Army Aviation Research and Development Command, Saint Louis, MO.) *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 38 p (For primary document see N91-18048 10-02)

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Rotorcraft aerodynamics is especially rich in unsolved problems, and for this reason the need for independent computational and experimental studies is great. Three-dimensional unsteady, nonlinear potential methods are becoming fast enough to enable their use in parametric design studies. At present, combined CAMRAD/FPR analyses for a complete trimmed rotor soltution can be performed in about an hour on a CRAY Y-MP (or ten minutes, with multiple processors). These computational speeds indicate that in the near future many of the large CFD problems will no longer require a supercomputer. The ability to convect circulation is routine for integral methods, but only recently was it discovered how to do the same with differential methods. It is clear that the differential CFD rotor analyses are poised to enter the engineering workplace. Integral methods already constitute a mainstay. Ultimately, it is the users who will integrate CFD into the entire engineering process and provide a new measure of confidence in design and analysis. It should be recognized that the above classes of analyses do not include several major limiting phenomena which will continue to require empirical treatment because of computational time constraints and limited physical

understanding. Such empirical treatment should be included, however, into the developing CFD, engineering level analyses. It is likely that properly constructed flow models containing corrections from physical testing will be able to fill in unavoidable gaps in the experimental data base, both for basic studies and for specific configuration testing. For these kinds of applications, computational cost is not an issue. Finally, it should be recognized that although rotorcraft are probably the most complex of aircraft, the rotorcraft engineering community is very small compared to the fixed-wing community. Likewise, rotorcraft CFD resources can never achieve fixed-wing proportions and must be used wisely. Therefore the fixed-wing work must be gleaned for many of the basic methods. Author

N91-18055# Johnson Aeronautics, Palo Alto, CA.
AIRLOADS, WAKES, AND AEROELASTICITY
Wayne Johnson *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 20 p Previously announced as N90-21738 (For primary document see N91-18048 10-02)
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Fundamental considerations regarding the theory of modeling of rotary wing airloads, wakes, and aeroelasticity are presented. The topics covered are: airloads and wakes, including lifting-line theory, wake models and nonuniform inflow, free wake geometry, and blade-vortex interaction; aerodynamic and wake models for aeroelasticity, including two-dimensional unsteady aerodynamics and dynamic inflow; and airloads and structural dynamics, including comprehensive airload prediction programs. Results of calculations and correlations are presented. Author

N91-18056# McDonnell-Douglas Helicopter Co., Mesa, AZ. Aero/Acoustics Div.
AEROACOUSTICS OF ROTORCRAFT
R. D. Janakiram *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 33 p (For primary document see N91-18048 10-02)
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A review of the state-of-the-art of rotorcraft aeroacoustics with emphasis on helicopter noise is presented. The fundamentals of rotorcraft aeroacoustics are discussed in terms of the underlying source mechanisms, theoretical models and prediction methodologies in three categories of rotor noise; rotational (non-impulsive) noise; impulsive noise including high-speed impulsive noise, blade-vortex interaction noise and main rotor/tail rotor interaction noise; and broadband noise. Key model rotor and flight test experiments are also discussed. Recent developments, especially those that occurred in the 1980s in the area or rotorcraft (or helicopter) aeroacoustics are discussed in three categories: aeroacoustic testing and data base development, noise prediction, and noise reduction. Author

N91-18057# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONSIDERATIONS ON WIND-TUNNEL TESTING TECHNIQUES FOR ROTORCRAFT
J. J. Philippe *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 34 p (For primary document see N91-18048 10-02)
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For many years, wind-tunnel testing is a necessity when designing and building a rotorcraft. The first reason is certainly the fact that numerical methods are still far from being capable of accurate rotor and fuselage performance prediction. Even if now there are more and more sophisticated codes, more and more detailed experimental results are needed in order to validate these codes and to fix their domain of validity. The second reason for wind-tunnel testing is to reduce risks and costs in rotorcraft development, especially if using a new design or if flying in a flight domain not yet explored or one that is considered dangerous. Try before flying is perhaps even more necessary for the rotary wing aircraft community than for the fixed-wing community, due to the complexity of the configurations involved in an aircraft having to assure vertical take-off, hover, and forward flight. The third reason for wind-tunnel testing is related to the need for optimized configuration: too many parameters are concerned with this aim and it would be unrealistic to try to build and test too many full-scale prototypes. Wind-tunnel testing is a good way to confirm the performance of a specific design and to select the most appropriate configuration to build for flight testing and validation. Author

N91-18058# Royal Aerospace Establishment, Bedford (England). Helicopter Aeromechanics Section.
EXPERIMENTAL TECHNIQUES IN HELICOPTER AERODYNAMICS FLIGHT RESEARCH
P. Brotherhood and M. J. Riley *In* AGARD, Aerodynamics of Rotorcraft Nov. 1990 25 p (For primary document see N91-18048 10-02)
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The techniques used in the study of main and tail rotor aerodynamics by measurements on full-scale helicopters in flight are described. The strengths and weaknesses of flight research are discussed and some comparisons with wind tunnel techniques are drawn. The application of various types of sensors is discussed together with a more general discussion on data acquisition, recording, and processing. Airworthiness aspects including fatigue damage monitoring are also considered. Examples which illustrate the various techniques and provide informative comparisons with theory are presented. The use of comparative techniques in which opposite blades in a single rotor are individually modified and the use of indicator sensors to supplement or replace complete chordwise pressure distributions are highlighted. Author

N91-18059 Leicester Univ. (England).
UNSTEADY AERODYNAMIC FORCES ON PARACHUTE CANOPIES Ph.D. Thesis
R. J. Harwood 1988 272 p
Avail: Univ. Microfilms Order No. BRD-90617

Unsteady force coefficients were determined for a range of parachute canopy models. These coefficients are required for prediction of the aerodynamic stability of full scale parachutes under conditions of unsteady motion during descent. The method of obtaining these coefficients required the collection of force and acceleration data for parachute canopy model which were tested in unsteady conditions. This was achieved by imposing oscillatory motion on individual canopies during towing tests. Two modes of unsteady motion were imposed on a canopy under test: one with axial oscillations; and one with lateral oscillations. A mathematical model describing such modes of motion consists of a general equation for the unsteady force developed on a bluff body. An identification technique is used to determine the mean values per cycle of each parameter by substitution of the data obtained from these tests as functional variables in the mathematical model. The results indicate a strong dependence in oscillatory motion of the mean value per cycle for the axial added mass coefficient on the unsteady force parameter. Dissert. Abstr.

N91-18060# Oak Ridge National Lab., TN. Applied Technology Div.
EVALUATION OF THERMOGRAPHIC PHOSPHOR TECHNOLOGY FOR AERODYNAMIC MODEL TESTING
M. R. Cates, K. W. Tobin, and D. Barton Smith Aug. 1990 31 p
(Contracts DE-AC05-84OR-21400; MIPR-EY-7483-89-0007)
(DE91-005631; ORNL/ATD-40) Avail: NTIS HC/MF A03

The goal for this project was to perform technology evaluations applicable to the development of higher-precision, higher-temperature aerodynamic model testing at Arnold Engineering Development Center (AEDC) in Tullahmoa, Tennessee. With the advent of new programs for design of aerospace craft that fly at higher speeds and altitudes, requirements for detailed understanding of high-temperature materials become very important. Model testing is a natural and critical part of the development of these new initiatives. The well-established thermographic phosphor techniques of the Applied Technology

Division at Oak Ridge National Laboratory are highly desirable for diagnostic evaluation of materials and aerodynamic shapes as studied in model tests. Combining this state-of-the-art thermographic technique with modern, higher-temperature models will greatly improve the practicability of tests for the advanced aerospace vehicles and will provide higher precision diagnostic information for quantitative evaluation of these tests. The wavelength ratio method for measuring surface temperatures of aerodynamic models was demonstrated in measurements made for this project. In particular, it was shown that the appropriate phosphors could be selected for the temperature range up to approximately 700 F or higher and emission line ratios of sufficient sensitivity to measure temperature with 1 percent precision or better. Further, it was demonstrated that two-dimensional image-processing methods, using standard hardware, can be successfully applied to surface thermography of aerodynamic models for AEDC applications. DOE

N91-18061# Los Alamos National Lab., NM.
AN EXPERIMENTAL INVESTIGATION OF THE PROPERTIES OF A NON-REACTING, SUPERSONIC SHEAR LAYER
P. J. Wantuck, R. E. Tennant, A. D. Rothstein, and H. H. Watanabe 1990 29 p Presented at the 29th AIAA Aerospace Sciences Conference, Reno, NV, 7-10 Jan. 1991 Previously announced in IAA as A91-21568
(Contract W-7405-eng-36)
(DE91-005856; LA-UR-90-4299; CONF-910117-4) Avail: NTIS HC/MF A03

A shear layer formed by the merging of two different mass density and velocity, supersonic, inert gas streams (Ar and He) was investigated using both intrusive (probes) and non-intrusive (laser-based) techniques. Interpretations based upon mean pitot pressure surveys, namely shear layer growth rate and compressibility agree with established data. An aspirating probe in conjunction with a mass spectrometer comprised a gas sampling system for ultimately obtaining concentration profiles. Rapid scanning of such flows is possible with such a technique but additional efforts are required to make quantitative concentration assignments. The technique does, however, provide a means of qualitatively assessing mixing rates. Finally, planar laser-induced fluorescence (PLIF) was used to establish spatially and temporally resolved images of the shear layer. Obtained images demonstrate the usefulness of PLIF to qualitatively monitor turbulent mixing phenomena in supersonic flows. DOE

N91-18062*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE EFFECTS OF VISCOSITY ON THE STABILITY OF A TRAILING-LINE VORTEX Final Report
Peter W. Duck and Mehdi R. Khorrami (High Technology Corp., Hampton, VA.) Jan. 1991 33 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187500; NAS 1.26:187500; ICASE-91-6) Avail: NTIS HC/MF A03 CSCL 01A

The linear stability of the Batchelor (1964) vortex is investigated. Particular emphasis is placed on modes found recently in a numerical study by Khorrami (1991). These modes have a number of features very distinct from those found previously for this vortex, including exhibiting small growth rates at large Reynolds numbers and susceptibility to destabilization by viscosity. These modes are described using asymptotic techniques, producing results which compare favorably with fully numerical results at large Reynolds numbers. Author

N91-18063*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
DEVELOPMENT OF THE WAKE BEHIND A CIRCULAR CYLINDER IMPULSIVELY STARTED INTO ROTATORY AND RECTILINEAR MOTION: INTERMEDIATE ROTATION RATES Final Report
Yen-Ming Chen, Yuh-Roung Ou, and Arne J. Pearlstein (Illinois Univ., Urbana-Champaign.) Jan. 1991 62 p Submitted for publication
(Contract NAS1-18605; AF-AFOSR-0079-89; AF-AFOSR-0156-90; NSF MSM-84-51157; NSF CTS-90-17181)
(NASA-CR-187512; ICASE-91-10; NAS 1.26:187512) Avail: NTIS HC/MF A04 CSCL 01A

The temporal development of two-dimensional viscous incompressible flow generated by a circular cylinder started impulsively into steady rotatory and rectilinear motion is studied by integration of a velocity/vorticity formulation of the governing equations, using an explicit finite-difference/pseudo-spectral technique and an implementation of the Biot-Savart law. Results are presented for a Reynolds number of 200 (based on the cylinder diameter 2a and the magnitude U of the rectilinear velocity) for several values of the angular/rectilinear speed ratio alpha = (omega x a)/U (where omega is the angular speed) up to 3.25. Several aspects of the kinematics and dynamics of the flow not considered earlier are discussed. For higher values of alpha, the results indicate that for Re = 200, vortex shedding does indeed occur for alpha = 3.25. The shedding process is; however, very different from that which gives rise to the usual Karman vortex street for alpha = 0. In particular, consecutive vortices shed by the body can be shed from the same side and be of the same sense, in contrast to the nonrotating case, in which mirror-image vortices of opposite sense are shed alternately on opposite sides of the body. The implications of the results are discussed in relation to the possibility of suppressing vortex shedding by open or closed-loop control of the rotation rate. Author

N91-18064*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
FOURIER FUNCTIONAL ANALYSIS FOR UNSTEADY AERODYNAMIC MODELING
C. Edward Lan and Suei Chin Feb. 1991 101 p
(Grant NAG1-1087)
(NASA-CR-187964; NAS 1.26:187964; KU-FRL-872-2) Avail: NTIS HC/MF A06 CSCL 01A

A method based on Fourier analysis is developed to analyze the force and moment data obtained in large amplitude forced oscillation tests at high angles of attack. The aerodynamic models for normal force, lift, drag, and pitching moment coefficients are built up from a set of aerodynamic responses to harmonic motions at different frequencies. Based on the aerodynamic models of harmonic data, the indicial responses are formed. The final expressions for the models involve time integrals of the indicial type advocated by Tobak and Schiff. Results from linear two- and three-dimensional unsteady aerodynamic theories as well as test data for a 70-degree delta wing are used to verify the models. It is shown that the present modeling method is accurate in producing the aerodynamic responses to harmonic motions and the ramp type motions. The model also produces correct trend for a 70-degree delta wing in harmonic motion with different mean angles-of-attack. However, the current model cannot be used to extrapolate data to higher angles-of-attack than that of the harmonic motions which form the aerodynamic model. For linear ramp motions, a special method is used to calculate the corresponding frequency and phase angle at a given time. The calculated results from modeling show a higher lift peak for linear ramp motion than for harmonic ramp motion. The current model also shows reasonably good results for the lift responses at different angles of attack. Author

N91-18065# Helsinki Univ. Technology, Otaniemi (Finland). Lab. of Aerodynamics.
NUMERICAL SIMULATION OF TRANSONIC FLOW AROUND AIRFOILS AT HIGH REYNOLDS NUMBERS USING ALGEBRAIC TURBULENCE MODELS
Jaakko Hoffren and Timo Siikonen 1990 33 p
(B-29; ISBN-951-22-0441-X; ISSN-0358-2620) Avail: NTIS HC/MF A03

Turbulent flows at high Reynolds numbers around airfoils are simulated with a finite volume Navier-Stokes solver. Two algebraic turbulence models are added to the FINFLO program, and the performance of the code is tested by comparisons with reference results, laying special emphasis on the accuracy of the calculated

force coefficients. The effects of some computation aspects are studied, and the efficiency of the code is briefly evaluated.
Author

N91-18066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SEA LEVEL STATIC CALIBRATION OF A COMPACT MULTIMISSION AIRCRAFT PROPULSION SIMULATOR WITH INLET FLOW DISTORTION
Mark J. Won Nov. 1990 181 p LIMITED REPRODUCIBILITY: More than 20% of this document may be affected by color photographs Original contains color illustrations
(NASA-TM-102838; A-90194; NAS 1.15:102838) Avail: NTIS HC/MF A09; 11 functional color pages CSCL 01A

Wind tunnel tests of propulsion-integrated aircraft models have identified inlet flow distortion as a major source of compressor airflow measurement error in turbine-powered propulsion simulators. Consequently, two Compact Multimission Aircraft Propulsion Simulator (CMAPS) units were statically tested at sea level ambient conditions to establish simulator operating performance characteristics and to calibrate the compressor airflow against an accurate bellmouth flowmeter in the presence of inlet flow distortions. The distortions were generated using various-shaped wire mesh screens placed upstream of the compressor. CMAPS operating maps and performance envelopes were obtained for inlet total pressure distortions (ratio of the difference between the maximum and minimum total pressures to the average total pressure) up to 35 percent, and were compared to baseline simulator operating characteristics for a uniform inlet. Deviations from CMAPS baseline performance were attributed to the coupled variation of both compressor inlet-flow distortion and Reynolds number index throughout the simulator operating envelope for each screen configuration. Four independent methods were used to determine CMAPS compressor airflow; direct compressor inlet and discharge measurements, an entering/exiting flow-balance relationships, and a correlation between the mixer pressure and the corrected compressor airflow. Of the four methods, the last yielded the least scatter in the compressor flow coefficient, approximately + or - 3 percent over the range of flow distortions.
Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N91-18067# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
PROGRESS IN MILITARY AIRLIFT
Dec. 1990 306 p In ENGLISH and FRENCH Symposium held in Lisbon, Portugal, 28-31 May 1990
(AGARD-CP-495; ISBN-92-835-0585-9) Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Although military transport aircraft and helicopters will continue to be of increasing importance in future military operations, military transport aircraft technology has not received the same level of attention that has been directed, for example, to combat aircraft. It is important and timely to review the area of military airlift and assess: the present and perceived future military roles and requirements; the required developments in technology; the extent to which civil technology applications can enhance capability; technologies for real cost reduction; and to what extent the current and future development programs in this field embody the new technologies. Included are operational experience and requirements; cockpit design and aircrew performance; specific technologies such as fuel, powerplant and aerodynamic design; and a review of current and new programs. For individual titles, see N91-18068 through N91-18093.

N91-18068# Aeronautical Systems Div., Wright-Patterson AFB, OH.
THE STUDY APPROACH AND PERCEIVED NEEDS FOR AN ADVANCED THEATER TRANSPORT
Vladimir Vukmir *In* AGARD, Progress in Military Airlift Dec. 1990 12 p (For primary document see N91-18067 10-03)
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The Advanced Transport Technology Mission Analysis (ATTMA) is a broad based investigation of future tactical airlift mission requirements and of the attendant technologies necessary to satisfy those requirements. The approach taken in the study effort and the perceived needs for a 21st century Advanced Theater Transport (ATT) are considered. The descriptors theater, tactical, and intratheater are used synonymously and are to be differentiated from a strategic or intertheater airlifter. Specific military airlift tasks are defined in detail for Europe, Southwest Asia, and Central America that are representative of the kinds of missions that are believed to drive the demand for theater airlift in the 21st century. These tasks then serve as a basis for comparing the productivity/effectiveness of alternative system options. Presented are the results of conceptual STOL and VSTOL airlifters relative to the current U.S. airlift fleet in accomplishing the tasks defined above. Perceived system deficiencies and corresponding needs are identified. One such need is improved cargo handling (loading/unloading and transshipment) for future theater airlifters operating into short, austere landing sites in or near a threat environment. When the many variations in intermodel interfaces with present or future airlifters and potential increase in the need for theater airlift on an international scale are considered, the cargo handling issue may be one of several that could benefit greatly from international cooperation.
Author

N91-18069# Sikorsky Aircraft, Stratford, CT. Advanced Design and Business Development.
DESIGN OF THE ADVANCED CARGO AIRCRAFT. THE US ARMY'S NEXT GENERATION TRANSPORT ROTORCRAFT: AN OVERVIEW
Chris Jaran *In* AGARD, Progress in Military Airlift Dec. 1990 8 p (For primary document see N91-18067 10-03)
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A family of rotorcraft were defined to meet the projected requirements of the U.S. Army for combat airlift in the year 2000 and beyond. A detailed definition of equipment and mission load inventories was developed, and a knowledge-based simulation assessed the capability of various-size aircraft to transport these inventories in three combat theaters: Europe, Southwest Asia, and Latin America. Payload capabilities of 18, 26, 30, and 39 thousand lb with 270 nm (500 km) radius of action at Army hot day ambients were identified as potentially cost effective design points. A 9 x 9 ft (2.74 x 2.74 m) cabin cross section was required, with a cabin length of 32 to 41 ft (9.75 to 12.5 m) depending on design payload. Single and tandem rotor helicopter solutions were defined for each of the four design payloads. A tilt rotor solution was also examined. A single rotor configuration with a design gross weight of 94,000 lb (42,637 kg), a rotor diameter of 122 ft (37.2 m), and three engines served as a baseline for evaluation of the impact of various design criteria and system technology levels.
Author

N91-18070# Construcciones Aeronauticas S.A., Madrid (Spain). Projects Div.
GENERAL CONFIGURATION ASPECTS ON AIRLIFTER DESIGN
J. L. LopezDiez, J. R. Herrera, and J. L. Asenjo *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067 10-03)
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The history and actual process followed at CASA for the analysis

of the requirements and selection of the most suitable configuration for a new Military Airlifter System are presented. The importance of an adequate initial choice of some parameters such as fuselage cross-section and length, wing area and geometry related to load and unload operations was emphasized. Peace time and war time operations must be taken into account to get a realistic view of essential factors such as fleet size and life-cycle cost for the transport system. Finally the availability of suitable powerplants is an important factor to fix the final specifications of a Military Airlifter System. Author

N91-18071# Plans du Transport Aerien Militaire, Velizy-Villacoublay (France).
LESSONS DRAWN FROM FRANCE'S RECENT OPERATIONAL EXPERIENCES REGARDING THE DESIGN OF MILITARY TRANSPORT AIRCRAFT [ENSEIGNEMENTS TIRES PAR LA FRANCE DE SES EXPERIENCES OPERATIONNELLES RECENTES EN MATIERE DE CONCEPTION D'AVIONS DE TRANSPORT MILITAIRE]
A. Bevillard *In* AGARD, Progress in Military Airlift Dec. 1990 8 p In FRENCH (For primary document see N91-18067 10-03)
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Since the end of the second world war the French military has conducted operations in a number of diverse theaters including Indochina, Algeria and Chad. Lessons drawn from these operational experiences, related to the design of military transport aircraft are discussed and specific design criteria for a future fleet of transport aircraft are defined. The essential characteristics of a future military transport include: (1) a cargo bay with a minimum height and width of 4 meters (larger than the current dimensions of the C-160 and C-130); (2) good tactical capabilities combined with a significant operating range; and (3) interoperability (since the development of this aircraft will require a european, if not an american-european cooperative effort. Transl. by M.G.

N91-18072# Joint Air Transport Establishment, Brize Norton (England).
RECENT IMPROVEMENTS TO THE RAF AIR TRANSPORT FORCE
D. MacIntosh *In* AGARD, Progress in Military Airlift Dec. 1990 7 p (For primary document see N91-18067 10-03)
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The most significant improvement to the United Kingdom's Military Air Transport Force in recent years is described: the procurement of the Lockheed L1011 Tristar aircraft into the RAF service. The reasons behind the introduction of the Tristar, and its subsequent modifications into three very capable tanker, freighter, and passenger carrying variants are outlined. Moreover, some of the aircraft's capabilities and drawbacks are discussed. In addition, and with a view to the future, some of the cost disadvantages of an aging air transport fleet are considered. Furthermore, the RAF approach to considering a timescale for the introduction of a possible replacement transport aircraft is presented. Author

N91-18073# Military Airlift Command, Scott AFB, IL. Reliability and Maintainability Technology Div.
C-130 ELECTRONIC COCKPIT: RELIABILITY AND MAINTAINABILITY TECHNOLOGY INSERTION PROGRAM (RAMTIP) **c06**
Robert L. Russell *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)
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The Reliability and Maintainability Technology Insertion Program (RAMTIP) is aimed at accelerating new technologies from the laboratory and applying them to Air Force weapon systems in an effort to improve reliability and maintainability (R and M). This RAMTIP project will replace some sixty analog type cockpit instruments in a Military Airlift Command (MAC) C-130E with six liquid crystal flat panel displays. Five displays are installed on the pilot's/copilot's instrument panel with a sixth display installed at the navigator's station. Designed in the mid-1950s, the C-130 has remained highly cost effective to procure and operate. This is due largely to the simplicity of its systems and the fact that its design and tooling costs have long since been amortized. The aircraft performs a diversity of missions quite well, but the repairing and stocking of obsolete analog type instruments has become logistically difficult and costly. The purpose is to demonstrate the operational effectiveness and suitability of active matrix liquid crystal flat panel displays in the C-130 and to validate the projected R and M improvements of this technology over electromechanical analog instruments and cathode ray tubes (CRT). Although work is still in progress, the successful development and integration of this technology offers significant potential improvement in R and M, redundancy with graceful degradation, and enhanced operational effectiveness. Once proven, this technology can be applied to a wide variety of other aircraft throughout the Air Force inventory and other Department of Defense services, as well as that of the commercial aircraft industry. Author

N91-18074# Aerospatiale, Toulouse (France). Div. Avions.
APPLICATION OF NEW TECHNOLOGIES IN THE DESIGN OF THE COCKPIT IN FUTURE MILITARY TRANSPORT AIRCRAFT [APPORT DES TECHNOLOGIES NOUVELLES DANS LA CONCEPTION DU POSTE DE PILOTAGE D'UN FUTUR AVION DE TRANSPORT MILITAIRE]
J. Borrel, M. Duturc, and G. Mitonneau *In* AGARD, Progress in Military Airlift Dec. 1990 20 p In FRENCH (For primary document see N91-18067 10-03)
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Aerospatiale's experiences in the design and development of cockpits for the Airbus-series aircraft and the C-160 military transport are discussed. The evolution of cockpit display instruments, automatic flight control, and flight management systems utilized for the Airbus series is summarized. The application of new technologies in the cockpits of future military transport aircraft is discussed. Transl. by M.G.

N91-18075# Aeritalia S.p.A., Naples (Italy). Flight Deck and Avionics Systems.
ADVANCED TECHNOLOGY APPLICATION IN THE FLIGHT DECK DESIGN FOR MILITARY TRANSPORT AIRCRAFTS
V. Afeltra and A. LaPastina *In* AGARD, Progress in Military Airlift Dec. 1990 8 p (For primary document see N91-18067 10-03)
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The continuous growing in systems/functions installed in the modern aircraft, imposed by the more and more demanding requirements in terms of performance and safety, is leading to the development and the application of new components and systems in the area of cockpit indication and automatic controller integration. The cathode ray tube (CRT) and other multifunction display technologies are rapidly replacing many of the dials, panels, and gauges of the old cockpit. Artificial intelligence and high level automation are emerging in digital avionics. These systems would take over the crew in many cockpit management functions such as reconfiguration to compensate fault or execute emergency procedures. The design and certification aspects are analyzed which relate to the adoption of these new technologies and some aspects of human factor engineering are discussed which become an integral part for the cockpit design, for the symbology, and for the logic integration of the function within the automatic control and display systems. Author

N91-18076# Aeronautical Systems Div., Wright-Patterson AFB, OH. Systems Program Office.
C-17 PILOTED COCKPIT TESTING **c05**
William G. Heckathorn *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067

10-03)
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The C-17 aircraft under development will have a worldwide airlift mission in both combat and peacetime environments. With only two pilots in the cockpit, (eliminating the navigator and flight engineers, standards of Military Airlift Command (MAC) operations) design and testing must be logically thought out and executed to enhance mission completion and reduce the pilot workload. Numerous test facilities are being used to test the state-of-the-art avionics, its interference with the pilots, and the ability of the pilots to accomplish this mission. Author

N91-18077# Military Airlift Command, Scott AFB, IL.
AIRCREW FATIGUE COUNTERMEASURES **c54**
Stephens F. McCauley *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)
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Since the earliest days of aviation, there have been aircraft accidents (now referred to as flight mishaps). In earlier times, mechanical malfunctions were blamed for the greater number of mishaps. Engineering and technological advances, however, have since lowered the likelihood of machine-induced mishaps. Now, the man part of the equation (in a chain of events leading to a mishap) is far more likely to be the primary cause. Thus, as aircraft are made more durable, reliable, and better able to sustain increased workloads, the humans who operate them must find ways to adapt or cope with the greater demands which result from improved machine capability. The bottom line question for today surfaces as: What causes crewmembers to commit errors in judgment, performance, or perception, and how might the influences of such causes be reduced. Progress in the field of human factors (HF) analysis has revealed some solutions while advancing the fundamental goal of flight safety - mishap prevention. The impact of HF studies on mishap prevention is clarified and summarized and how aircrew fatigue is a common denominator among HF elements is shown. Accepted techniques for combating and coping with fatigue are listed. Finally, recommendations on how to maintain operational awareness of aircrew fatigue considerations are proposed. Author

N91-18078# Military Airlift Command, Scott AFB, IL. Test and Evaluation Div.
AIRCREW EYE/RESPIRATORY PROTECTION: A MILITARY AIRLIFT COMMAND PERSPECTIVE **c54**
James Sousa *In* AGARD, Progress in Military Airlift Dec. 1990 9 p (For primary document see N91-18067 10-03)
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The effort of the Military Airlift Command (MAC) and the Air Force System Command (AFSC) to improve aircrew eye/respiratory protection (AERP) in the chemical defence environment is summarized. The significant effort to plan the concept, manage the acquisition, design the system, test the system, and redesign the system to meet the MAC requirements is discussed. The MAC mission to conduct and support operations remains the same during war and peacetime and despite the presence of chemical agents. An effective AERP system is needed to support the worldwide operations. The ongoing test effort has uncovered important problems and challenges to overcome. However, after hundreds of ground and over 50 flight test hours in the MAC mission environment, solutions are on the way. More challenges exist now, but the numerous hurdles already cleared have prepared a way to proceed. Author

N91-18079# Department of National Defence, Ottawa (Ontario). Operational Research and Analysis Establishment.
EVALUATION OF A NEW FUEL WITH HIGHER ENERGY DENSITY **c28**
P. E. Desmier and R. R. Hastings *In* AGARD, Progress in Military Airlift Dec. 1990 17 p (For primary document see N91-18067 10-03)
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In order to increase the range and endurance of fighters operating in the far northern regions of Canada, and to extend maritime surveillance capability with existing aircraft assets, the Department of National Defence of Canada has pursued the development of an aviation fuel with a high energy density. The fuel selection criteria included: an energy increase of at least 10 percent by volume over current NATO F40/JP-4; acceptable performance and durability impact on aircraft systems; and large scale availability at reasonable cost. A description of the analysis is provided which was used to determine the potential benefits to be derived from the use of a high energy density fuel. Mission analyses included discussions which cover fighter (CF-18), maritime surveillance (CP-140 Aurora), and tankers (CC-137 and KC-130), aircraft. The fuel characteristics which were perceived to have a potential impact on aircraft or engine military performance are discussed. The results of engine component rig tests are then briefly discussed to demonstrate how critical fuel blend factors were evaluated to ensure that an optimal energy/performance blend was determined. Finally, a description is provided on testing objectives for the subsequent full scale engine performance and durability testing as well as an outline of the final flight certification program for the High Density Fuel (HDF). The test results to date are most encouraging. There appears to be considerable potential for the introduction of HDF to military service. Author

N91-18080# British Aerospace Aircraft Group, Woodford (England). Airlines Div.
THE POWERPLANT OPTIONS FOR A FUTURE LARGE AIRCRAFT **c07**
D. G. Spencer and R. S. Clough *In* AGARD, Progress in Military Airlift Dec. 1990 13 p Prepared in cooperation with Rolls-Royce Ltd., Derby, England (For primary document see N91-18067 10-03)
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Future large aircraft is a generic term used to describe a future medium sized tactical transport aircraft and derivatives for other roles. Its design will utilize modern technology to provide a replacement for airforces' mixed fleets of Hercules, Transall, and a multitude of other aircraft used in tanking, maritime patrol, and other such roles. Studies conducted so far have shown the powerplant to be the key technology for a new military transport aircraft. Relative to the Hercules and the Transall, large gains in capability, savings in cost, are available with modern powerplants. The influence of powerplant selection is so critical that it is likely to drive the mission capability that can be economically provided. The main design requirements are identified for this type of aircraft. The benefits of modern technology when applied to both airframe and engine in a military transport are discussed. Turboprop, turbofan, and propfan engines are compared, and the benefits and availability of civil engines reviewed. Finally, several different aircraft solutions are presented, covering the range of possible powerplants, and their characteristics compared. Author

N91-18081# Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, Corbeil (France). Centre d'Essais de Villaroche.
IMPROVING MILITARY TRANSPORT AIRCRAFT THROUGH HIGHLY INTEGRATED ENGINE-WING DESIGN
A. Lardellier *In* AGARD, Progress in Military Airlift Dec. 1990 15 p (For primary document see N91-18067 10-03)
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Current studies have shown the interest of very large bypass ratio (BPR) engines (10 is less than BPR is less than 14) to power Long Range Airliners, at cruise speed exceeding Mach 0.8. A further benefit in terms of installed SFC (specific fuel consumption) can be expected for Future Large Aircraft (FLA), cruising at Mach 0.75. Compared to an equivalent turbofan, a very large bypass engine can deliver a higher thrust during takeoff,

thus improving the high lift capability of the aircraft. Taking into account that a conventional front fan engine is likely to show a large radar cross section (RCS), and that this problem would have to be addressed for FLA, the engine perferred concept is a ducted aft contrafan. The resulting high hub-tip ratio fan flow path, combined with slow rotating composite fan-blades is indeed a good approach toward reduction of the engine RCS. In order to minimize the extra-weight due to the long duct, a highly integrated engine-wing design is proposed, offering a reduced friction drag; particular attention is paid to the maintenance and transportation problems. Author

N91-18082# De Havilland Aircraft Co. of Canada Ltd., Downsview (Ontario). Powered Lift Technology Div.

THE DEVELOPMENT OF VERY THICK MULTI-FOIL WINGS FOR HIGH SPEED, POWERED LIFT TRANSPORT AIRCRAFT APPLICATIONS **c05**

J. E. Farbridge *In* AGARD, Progress in Military Airlift Dec. 1990 20 p Sponsored in part by Department of National Defence, Ottawa, Ontario and Department of Industry, Ottawa, Ontario (For primary document see N91-18067 10-03)

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The theoretical development of the multi-foils between 18 and 30 percent thickness/chord is discussed and results are presented from high Reynolds number, high speed, 2D and 3D tunnel tests on foils up to 24 percent thickness/chord ratio. Both blown and unblown characteristics of the foils are reviewed. The integration of these multi-foil sections into high speed advanced USTOL (Ultra-Short Takeoff and Landing) transport aircraft studies using the ejector flap concept led to the potential for very efficient cruising transport aircraft with USTOL capability using only the thrust required for cruise. Several other potential applications for thick multi-foil section are also discussed. Author

N91-18083*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF ADVANCED TECHNOLOGIES TO FUTURE MILITARY TRANSPORTS

Rodney L. Clark, Roy H. Lange (Lockheed Aeronautical Systems Co., Marietta, GA.), and Richard D. Wagner *In* AGARD, Progress in Military Airlift Dec. 1990 8 p (For primary document see N91-18067 10-03)

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Long range military transport technologies are addressed with emphasis of defining the potential benefits of the hybrid laminar flow control (HLFC) concept currently being flight tested. Results of a 1990's global range transport study are presented showing the expected payoff from application of advanced technologies. Technology forecast for military transports is also presented. Author

N91-18084# Military Airlift Command, Scott AFB, IL.

C-130 REAR VISION DEVICE (BUBBLE) **c05**

Mark Julicher *In* AGARD, Progress in Military Airlift Dec. 1990 5 p (For primary document see N91-18067 10-03)

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Three devices for providing rearward vision were developed and tested. The first device was a standard HC-130 observation door as used in search and rescue operations. The second device was a 180 deg field-of-view (FOV) bubble mounted on the cockpit overhead escape hatch. The third device was similar to the second but provided a 360 deg FOV. The three devices were tested at various exercises and in special sorties against fighters. The test findings confirmed that the 360 deg FOV bubble proved to be the best of the three devices for warning against air-to-air attack and for observing the attacking aircraft during evasive maneuvers. A great deal of experience has now been gained through bubble operations. That experience can be conveniently divided into three parts: equipment, training, and the tactics. Those three topics and the future of the rear vision device program are also discussed. Author

N91-18085# Wright Research Development Center, Wright-Patterson AFB, OH. Technology Exploitation Directorate.

TECHNOLOGY AND DESIGN CONSIDERATIONS FOR AN ADVANCED THEATER TRANSPORT **c05**

Richard V. Wible *In* AGARD, Progress in Military Airlift Dec. 1990 11 p (For primary document see N91-18067 10-03)

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The design and technology issues posed by the perceived mission requirements for a twenty first century theater transport are addressed. The theater transport of the future will be called upon to operate throughout the world in a variety of climatic conditions, into and out of remote and austere locations with unimproved runways, limited or non-existing landing aids, and in many cases no cargo handling equipment. Such an airlifter will be required to operate near, and occasionally, into enemy territory, where the threat will be more lethal than in the past. The design and technology implications of these perceived requirements are discussed relative to three design/technology issues: field length, which addresses both the impact of takeoff and landing rules on Short Takeoff and Landing aircraft design, and the impact of propulsion and vertical lift payload on Vertical or Short Takeoff and Landing aircraft design; payload/aircraft size, which addresses typical theater transport payloads, productivity as a function of payload and the contribution of advanced materials on aircraft size; and survivability, which addresses the impact of low observables considerations upon theater transport design. Author

N91-18086# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).

APPLICATION OF CIVIL AIR TRANSPORT TECHNOLOGY TO MILITARY AIRLIFT

Johannes Spintzyk *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067 10-03)

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Due to a strong market demand and competition the civil passenger aircraft have improved considerably in performance and operating cost in the last 30 years. These improvements were achieved mainly by progress in technology. Comparable improvements were not achieved in military aircraft. The military transport aircraft in operation today are of older design. Civil and military transport technologies are identical to a large extent. Therefore, application of the advanced civil transport technology to a new military transport aircraft promises a leap in performance improvements and operating cost reductions. Moreover, changes in tasks and requirements can be incorporated in a new design. The example of an advanced medium transport aircraft shows promising indications of the improvements which are possible by applying civil transport technology and encourages further investigations. Author

N91-18087# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Fixed Wing Engineering Section.

PROBLEMS IN CONVERTING CIVIL AIRCRAFT TO THE MILITARY TANKER ROLE **c05**

R. J. Kilford *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)

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Military tanker aircrafts are being increasingly produced by conversion of civil airliners. Civil and military aircrafts are designed to different philosophies and operated in different ways, the civil operation being predictable, the military less so. These different philosophies are discussed, as well as the problems arising from typical aircraft conversions. It is also suggested how future conversions can benefit from the lessons of the past. Author

N91-18088# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
C 160-TRANSALL LIFE TIME EXTENSION **c05**
Hartmut Griem *In* AGARD, Progress in Military Airlift Dec. 1990 13 p (For primary document see N91-18067 10-03)
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The C 160-Transall aircraft is described. Procedures for life time extension are discussed. The following subject areas are covered: measures referring to structure; systems modifications and replacements; and program procedures, documentation; and data bases. Y.S.

N91-18089# Lockheed Aeronautical Systems Co., Palmdale, CA.
THE HIGH TECHNOLOGY TEST BED: A RESEARCH PROGRAMME FOR TECHNOLOGY DEVELOPMENT **c05**
C. B. Payne *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067 10-03)
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Proposed roles for future tactical airlift drive requirements for research and development in the areas of advanced Short Takeoff and Landing (STOL), Electronic Systems, Survivability, and Advanced Cockpit capabilities. A common scenario may involve deep penetration into enemy territory with no air or ground support. The transport may be required to land on bomb damaged runways, highways, or dirt roads. The aircraft may have to take on cargo in this area and get airborne again with the same runway requirement. The High Technology Test Bed (HTTB), an Independent Research and Development Program (IRAD) was begun to address technologies required for these future tactical transports. The program utilizes a commercial, stretched C-130 transport as the technology focal point. The aircraft is highly modified to perform the STOL mission and is fully instrumented with a real time data acquisition system. The HTTB undergoes modification spans followed by flight spans to evaluate systems performance.
Author

N91-18090# Douglas Aircraft Co., Inc., Long Beach, CA.
THE C-17: MODERN AIRLIFTER REQUIREMENTS AND CAPABILITIES **c05**
Leonard R. Tavernetti *In* AGARD, Progress in Military Airlift Dec. 1990 10 p (For primary document see N91-18067 10-03)
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The newest military airlift aircraft C-17 can rapidly move substantial quantities of large, modern weaponry in fighting condition any place on the globe. The new air transport capability capitalizes on proven technology which is currently incorporated into today's commercial airliners and front-line fighter aircraft. It is described how existing technology is being applied on the C-17 to satisfy the requirements for modern military airlift aircraft. The C-17 expands the traditional airland and airdrop modes of transportation to include direct delivery of large outsize equipment. This airlifter transports M-1 tanks, AH-64 helicopters, and Bradley Fighting Vehicles, and delivers them to semiprepared austere airfields. The aircraft is operated by a crew of three employing fly-by-wire and mission computer technologies to integrate information and operations. Author

N91-18091# British Aerospace Aircraft Group, Woodford (England). Airlines Div.
FIMA AND EUROFLAG: PROGRESS IN MEETING MILITARY AIRLIFT AND FLA REQUIREMENTS FOR THE 21st CENTURY
D. K. Empson *In* AGARD, Progress in Military Airlift Dec. 1990 10 p (For primary document see N91-18067 10-03)
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Progress is reviewed made initially by the Future International Military Airlifter (FIMA) Group and, since 1989, by its successor the European Future Large Aircraft Group (EUROFLAG), in studying the potential for development of a collaborative program to satisfy airlift requirements for the 21st century. EUROFLAG studies indicate that future military transport and other Future Large Aircraft (FLA) designs based on mid-1990's, modern but proven technology standards, can provide a greatly enhanced airlift capability at significantly lower fleet life cycle costs and with major manpower savings compared with aircraft in service today. Theses attributes are important in a world climate of shrinking defence budgets, growing manpower shortages and defence scenario uncertainties. European or transatlantic collaboration to develop and manufacture such aircraft is seen as the most economical way for air forces to obtain the operational capability required at the lowest cost.
Author

N91-18092# Boeing Helicopter Co., Philadelphia, PA.
V-22 OPERATIONAL CAPABILITIES
Robert B. Taylor *In* AGARD, Progress in Military Airlift Dec. 1990 9 p (For primary document see N91-18067 10-03)
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The operational capabilities of the V-22 Osprey, the world's first operational tilt rotor aircraft, are described. The designed-in capabilities of the V-22, plus its performance characteristics, provide a multi-mission aircraft that will improve the capability of all service forces well into the 21st century. Key elements in providing a broad operational capability are shipboard compatibility, payload-range, maneuverability, high speed capability with an external load, reduced vulnerability, and glass cockpit integrated avionics for reduced pilot workload during day and night missions.
Author

N91-18093# Westland Helicopters Ltd., Yeovil (England).
TACTICAL SUPPORT EH101
J. C. Fielding *In* AGARD, Progress in Military Airlift Dec. 1990 10 p (For primary document see N91-18067 10-03)
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The development and use of military tactical helicopters from the early beginnings to the present day are reviewed. The background to the EH101 is presented explaining the rationale of its design philosophy and the application of technology and equipments to meet the requirements of the late '90s and the early 21st century. The operational capabilities and applications of the EH101 related to a changing fast-moving battlefield environment are also discussed. Author

N91-18094*# Vigyan Research Associates, Inc., Hampton, VA.
A REAL TIME DYNAMIC DATA ACQUISITION AND PROCESSING SYSTEM FOR VELOCITY, DENSITY, AND TOTAL TEMPERATURE FLUCTUATION MEASUREMENTS
Steven J. Clukey Feb. 1991 278 p
(Contract NAS1-18585)
(NASA-CR-182069; NAS 1.26:182069) Avail: NTIS HC/MF A08 CSCL 01C

The real time Dynamic Data Acquisition and Processing System (DDAPS) is described which provides the capability for the simultaneous measurement of velocity, density, and total temperature fluctuations. The system of hardware and software is described in context of the wind tunnel environment. The DDAPS replaces both a recording mechanism and a separate data processing system. DDAPS receives input from hot wire anemometers. Amplifiers and filters condition the signals with computer controlled modules. The analog signals are simultaneously digitized and digitally recorded on disk. Automatic acquisition collects necessary calibration and environment data. Hot wire sensitivities are generated and applied to the hot wire data to compute fluctuations. The presentation of the raw and processed data is accomplished on demand. The interface to DDAPS is described along with the internal mechanisms of DDAPS. A summary of operations relevant to the use of the DDAPS is also provided. Author

N91-18095# Technische Univ., Munich (Germany, F.R.). Institut fuer Luft- und Raumfahrt.
A SAFETY ANALYSIS OF COMMERCIAL AIRPLANE DITCHING Ph.D. Thesis [EINE SICHERHEITSANALYSE DER NOTWASSERUNG VON VERKEHRSFLUGZEUGEN]
Christian Jahncke 1989 165 p In GERMAN
(ETN-91-98801) Avail: NTIS HC/MF A08

Based on the simulation program developed for Extended Range Operations (EROPS) aircrafts, possible rescue systems and their probabilities are described. The restrictions of flight control through weather influence, by example of the North Atlantic Ocean are determined, and safety examinations for various service conditions are carried out. ESA

N91-18006*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FUTURE REGIONAL/COMMUTER CHALLENGES Abstracts Only
W. Don Harvey *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 2 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03 CSCL 01C

N91-18020# Wichita State Univ., KS. National Inst. for Aviation Research.
AVIATION SAFETY ENHANCEMENTS THROUGH THE INTERNATIONAL AIRCRAFT DATABASE RESEARCH PROJECT Abstract Only
John Hutchinson and Brent Bowen *In its* Proceedings: Techfest 17 1991 p 19 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18021# Wichita State Univ., KS. Dept. of Mechanical Engineering.
COMPUTER SIMULATIONS OF AN AIRCRAFT OCCUPANT-RESTRAINT SYSTEM Abstract Only
Deren Ma and Hamid M. Lankarani *In its* Proceedings: Techfest 17 1991 p 20 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18028# Kansas Univ., Lawrence. Dept. of Aerospace Engineering.
ON THE FEASIBILITY OF SMALL, VERY-LONG-RANGE CIVIL TRANSPORTS Abstract Only
Jan Roskam *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 26 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18029# Merkel Aircraft Co., Wichita, KS.
SPORT AVIATION AND SAFETY Abstract Only
Edwin Merkel *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 27 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N91-18096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE FOUR-DIMENSIONAL FLIGHT MANAGEMENT IN A TIME-BASED AIR TRAFFIC CONTROL ENVIRONMENT
David H. Williams and Steven M. Green (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) Washington Mar. 1991 35 p
(NASA-TM-4249; L-16825; NAS 1.15:4249) Avail: NTIS HC/MF A03 CSCL 17G

Advanced Air Traffic Control (ATC) systems are being developed which contain time-based (4D) trajectory predictions of aircraft. Airborne flight management systems (FMS) exist or are being developed with similar 4D trajectory generation capabilities. Differences between the ATC generated profiles and those generated by the airborne 4D FMS may introduce system problems. A simulation experiment was conducted to explore integration of a 4D equipped aircraft into a 4D ATC system. The NASA Langley Transport Systems Research Vehicle cockpit simulator was linked in real time to the NASA Ames Descent Advisor ATC simulation for this effort. Candidate procedures for handling 4D equipped aircraft were devised and traffic scenarios established which required time delays absorbed through speed control alone or in combination with path stretching. Dissimilarities in 4D speed strategies between airborne and ATC generated trajectories were tested in these scenarios. The 4D procedures and FMS operation were well received by airline pilot test subjects, who achieved an arrival accuracy at the metering fix of 2.9 seconds standard deviation time error. The amount and nature of the information transmitted during a time clearance were found to be somewhat of a problem using the voice radio communication channel. Dissimilarities between airborne and ATC-generated speed strategies were found to be a problem when the traffic remained on established routes. It was more efficient for 4D equipped aircraft to fly trajectories with similar, though less fuel efficient, speeds which conform to the ATC strategy. Heavy traffic conditions, where time delays forced off-route path stretching, were found to produce a potential operational benefit of the airborne 4D FMS. Author

N91-18097# Engineering and Economics Research, Inc., Vienna, VA.
AIR TRAFFIC CONTROL AND AIRSPEED SYSTEMS 2010 AIR TRAFFIC CONTROL OPERATIONAL CONCEPT Final Technical Report
Alex Bridewell, Kent Simmons, and Tom Pickerel 30 Apr. 1990 23 p
(Contract F19628-87-C-0172)
(AD-A229003) Avail: NTIS HC/MF A03 CSCL 17/7

The purpose of this report is to present an operations concept which delineates the expected personnel and equipment interactions between DoD ATC facilities and the FAA NAS in the year 2010. In order to portray these interactions, scenarios will be used. Two scenarios were defined - one showing a military aircraft progressing through the NAS and a second showing how a DoD aircraft will transition from the military ATC system into Special Use Airspace (SUA) and back to the military ATC. The intent is to show, in an animated format, the interactions between personnel, including the required information to be passed, and the hardware/software interfaces necessary to pass the information. GRA

N91-18098# Engineering and Economics Research, Inc., Vienna, VA.
DEPARTMENT OF DEFENSE AIR TRAFFIC CONTROL AND AIRSPACE SYSTEMS INTERFACE WITH THE NATIONAL AIRSPACE SYSTEM Final Report
Alex Bridewell, Tom Pickerel, and Kent Simmons 30 Mar. 1990 65 p
(Contract F19628-87-C-0172)
(AD-A229088) Avail: NTIS HC/MF A04 CSCL 17/7

This report assesses the intra-agency interoperability of a broad spectrum of ATC and airspace management systems. The FAA NAS plan is summarized to describe the national system that will exit in 1999. Military ATC systems are projected to the same period and evaluated by type of system (i.e., fixed or tactical), application (i.e., radar, position/navigation, communications, etc.), and branch of military service. The evaluation includes a discussion of the expected interfaces between military and civil system components. The assessment describes potential impacts of incompatible and non-interoperable systems on the DoD in terms

of safety and operational effectiveness and probable impacts on specific Air Force mission requirements. The report does not assess in depth the DoD's tactical ATC components or the tactical command and control systems that are not directly related to ATC. GRA

N91-18099# Human Factors Solutions, Rockville, MD.
FUTURE NORTH AMERICAN AIR TRAFFIC CONTROL SYNERGY HUMAN FACTORS SOLUTION Final Technical Report
Pamela Myers Dec. 1989 17 p
(Contract F19628-89-C-0099)
(AD-A229255) Avail: NTIS HC/MF A03 CSCL 17/7

This innovative research effort was proposed in response to the challenge of integrating the lessons learned in developing the American and Canadian airspace systems into the planning process for an interoperable, trans-century, North American airspace system. The intent was to identify opportunities for increasing efficiencies, reciprocal benefits, and cooperation between the U.S. and Canada which would result in a proposed functional organizational matrix. This strawman organization would provide DoD with a framework for mutual airspace management gains between the U.S. and Canada. GRA

N91-18100# Federal Aviation Administration, Atlantic City, NJ.
DIFFERENTIAL GPS TERMINAL AREA TEST RESULTS Technical Report, Nov. 1989 - Nov. 1990
L. Frank Persello Nov. 1990 62 p
(Contract T0704E)
(DOT/FAA/CT-TN90/48) Avail: NTIS HC/MF A04

Flight tests conducted by the Federal Aviation Administration (FAA) Technical Center to examine the performance of the differential global positioning system (DGPS) in the terminal area are described. The tests employed a Convair 580 (CV 580) and a pair of Motorola Eagle Mini Rangers. With the advent of a maturing global positioning system (GPS) constellation, the FAA is assuming a more intensive stance in addressing the many questions/problems associated with GPS. These DGPS tests investigated the obtainable accuracy under static and dynamic conditions. The static tests employed survey points as a baseline. The dynamic tests incorporated terminal area flight profiles and nonprecision approaches using a laser tracker as a baseline. The accuracy performance of DGPS showed an order of magnitude improvement in the static environment and a 4 to 5 fold improvement in the dynamic environment over stand alone GPS. The DGPS tests were conducted in an effort to build an FAA DGPS data base to aid in addressing GPS questions/problems. Author

N91-18101# Federal Aviation Administration, Atlantic City, NJ.
CHICAGO O'HARE SIMULTANEOUS ILS APPROACH DATA COLLECTION AND ANALYSIS Technical Report, Jan. 1989 - Feb. 1990
James Thomas and Dominic Timoteo Apr. 1990 149 p
(Contract F2006A)
(DOT/FAA/CT-TN90/11) Avail: NTIS HC/MF A07

Data on aircraft execution simultaneous instrument landing system (ILS) approach in instrument meteorological conditions were collected at Chicago O'Hare International Airport (ORD) between January 24 and March 14, 1989, for the purposes of analyzing the ILS navigational characteristics of these aircraft. Aircraft position data were collected using the in-place ORD airport surveillance primary and secondary radars. The data were reduced and analyzed at the FAA Technical Center to provide a measure of dispersion about the approach centerline and containment within various zones and envelopes of interest surrounding the approach centerline. Conclusions concerning the approach flight characteristics are drawn and recommendations are made concerning potential applications. Author

N91-18102# Computer Technology Associates, Inc., McKee City, NJ.
SIMULATION OF QUADRUPLE SIMULTANEOUS PARALLEL ILS APPROACHES AT D/FW, PHASE 3 Final Report, Sep. 1989 - Aug. 1990
T. Fischer, G. Yastrop, and B. Startzel-Dehel Aug. 1990 127 p
(Contract DTFA03-89-C-00023)
(DOT/FAA/CT-90/15) Avail: NTIS HC/MF A07

This was phase 3 of an ongoing effort to evaluate plans for increasing air traffic capacity in the Dallas/Fort Worth (D/FW) area. The objective was to evaluate the traffic handling ability of controllers during Instrument Meteorological Conditions (IMC) for D/FW's proposed quadruple parallel approach airport configuration using a real time air traffic control (ATC) simulation. Both dual and quadruple simultaneous parallel Instrument Landing System (ILS) approaches were simulated with controllers monitoring approach traffic. Blunders were introduced by having simulated aircraft deviate toward adjacent localizers. Some of the blundering aircraft also simulated a loss of radio communication. The ability of the controllers to maintain distance between blundering aircraft and aircraft in parallel approaches was the central issue. Also, a few runs evaluated the missed approach procedures with the controllers monitoring the departing and missed approach aircraft. Based upon the findings of the simulation, it was concluded that the quadruple simultaneous parallel ILS approach procedures are safe and workable for the airport configuration tested. Therefore, the operations at D/FW were recommended. Author

N91-18103# Rijksluchtvaartdienst, The Hague (Netherlands).
[ACTIVITIES REPORT OF THE CIVIL AERONAUTICS BOARD] Annual Report, 1989 [RIJKSLUCHTVAARTDIENST, JAARVERSLAG 1989]
1990 70 p In ENGLISH and DUTCH
(ETN-91-98773) Avail: NTIS HC/MF A04

The activities of the Dutch Civil Aeronautics Board in the fields of air traffic inspection, transport and infrastructure, air traffic security, air traffic and environment, air traffic responsibility, the safety of air traffic above the North Sea, aerodynamics, flight tests and simulation, construction and materials, and computer sciences for aeronautics, are summarized. ESA

N91-18104# Technische Univ., Brunswick (Germany, F.R.).
EXAMINATIONS OF THINNING OUT A DIRECTION FINDER ANTENNA FOR THE DAS AIRPLANE NAVIGATION SYSTEM Ph.D. Thesis [UNTERSUCHUNGEN ZUR AUSDUENNUNG EINER PEILANTENNE FUER DAS FLUGZEUGNAVIGATIONSSYSTEME DAS]
Uwe Kummer 1990 141 p In GERMAN
(ETN-91-98789) Avail: NTIS HC/MF A07

The characteristics of an azimuthal angular measurement device was described. The Distance measuring equipment based Azimuth System (DAS) was used in connection with the Distance Measuring Equipment (DME), in order to determine the distance and the lines of position of airplanes. The scanned receiving signal was subjected to a discrete Fourier transformation, in order to determine the incident directions of signals. A special signal to interference ratio was defined to characterize the immunity from disturbances. Using a special program, the minimum interference ratios of a pair of variates were obtained and compared. The characteristics of the best arrangements with minimum interference ratios were listed. They showed a better resistance to spurious signals. ESA

N91-18007*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DOPPLER GLOBAL VELOCIMETRY
Jim Usry *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 3-4 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03 CSCL 17G

N91-18309*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
DEMONSTRATION OF PRECISE ESTIMATION OF POLAR MOTION PARAMETERS WITH THE GLOBAL POSITIONING SYSTEM: INITIAL RESULTS
S. M. Lichten *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 1-8 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 17G

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N91-18105*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A METHODOLOGY FOR DESIGNING AIRCRAFT TO LOW SONIC BOOM CONSTRAINTS
Robert J. Mack and Kathy E. Needleman (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington Feb. 1991 24 p
(NASA-TM-4246; L-16768; NAS 1.15:4246) Avail: NTIS HC/MF A03 CSCL 01C

A method for designing conceptual supersonic cruise aircraft to meet low sonic boom requirements is outlined and described. The aircraft design is guided through a systematic evolution from initial three view drawing to a final numerical model description, while the designer using the method controls the integration of low sonic boom, high supersonic aerodynamic efficiency, adequate low speed handling, and reasonable structure and materials technologies. Some experience in preliminary aircraft design and in the use of various analytical and numerical codes is required for integrating the volume and lift requirements throughout the design process. Author

N91-18106# Federal Aviation Administration, Atlantic City, NJ.
EVALUATION OF MAGNETIC FUEL TREATMENT FOR AIRCRAFT FUEL SYSTEMS
Earl Lee and Augusto M. Ferrara Jan. 1991 30 p
(DOT/FAA/CT-TN90/54) Avail: NTIS HC/MF A03

The Federal Aviation Administration Technical Center evaluated a device which is intended to improve the fuel efficiency of both piston and turbine engines. This device is marketed by Magnetizer Group Incorporated. The theory behind the device calls for passing the fuel through a magnetic field, which alters the fuel's behavior. The device was evaluated on a Teledyne Continental 0-200. There were no significant changes in either the fuel consumption or the power developed when the device was installed. Author

N91-18107# Royal Aerospace Establishment, Farnborough (England).
THE PREDICTION OF CARRIAGE LOADS AND CHANGES IN AIRCRAFT LONGITUDINAL STABILITY FOR PYLON MOUNTED STORES AT SUBSONIC SPEEDS
D. Isaacs 9 Aug. 1990 34 p Presented at Royal Society Conference Carriage Integration and Release, Bath, England, Apr. 1990
(RAE-TM-AERO-2195; BR115362; ETN-91-98628) Copyright Avail: NTIS HC/MF A03

A method to calculate carriage loads for stores on wing mounted pylons and the effect of those stores on the parent aircraft stability at subcritical speeds is presented. The usual approach to modeling with distributions of sources to represent fuselage, store, wing and pylon displacement effects was used; the lifting effects of wings and pylons were modeled with a vortex lattice. The method is shown to have sufficient accuracy at low or moderate Mach numbers. Examples of fighter aircraft wings were examined and showed that good prediction results are obtained if the flow is subcritical. ESA

N91-18108# Technische Univ., Berlin (Germany, F.R.). Fachbereich Verkehrswesen.
FUEL MANAGEMENT SYSTEM FOR FUTURE COMMERCIAL AIRPLANES Ph.D. Thesis [FUEL MANAGEMENT SYSTEME FUER ZUKUENFTIGE VERKEHRSFLUGZEUGE]
Herbert Bernard 1990 143 p In GERMAN
(ETN-91-98796) Avail: NTIS HC/MF A07

A concept is presented for a new type of fuel management system, allowing a higher accuracy of fuel gage determination. The pilots are relieved of control tasks and of the manual operation of fuel distribution. The operational functionality of such a computer aided system is checked with a software prototype. ESA

N91-18012# Cessna Aircraft Co., Wichita, KS.
DESIGNING AIRCRAFT STRUCTURES FOR TOLERANCE TO FATIGUE DAMAGE Abstract Only
Robert B. Held and Dennis L. Longhofer *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 8 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18013# Cessna Aircraft Co., Wichita, KS.
AIRFRAME CORROSION Abstract Only
L. Ayala *In* Wichita State Univ., Proceedings: Techfest 17 1991 p 9 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18023# Wichita State Univ., KS. National Inst. for Aviation Research.
EXPERIMENTAL STUDIES OF GENERAL AVIATION WINGS AT HIGH ANGLES OF ATTACK Progress Report Abstract Only
Melvin H. Snyder *In its* Proceedings: Techfest 17 1991 p 22 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18024# Wichita State Univ., KS. Dept. of Mechanical Engineering.
MODELING HIGH ANGLE-OF-ATTACK FORCES AND MOMENTS USING A NEURAL NETWORK Abstract Only
James E. Steck and Kamran Rokhsaz (Missouri Univ., Rolla.) *In its* Proceedings: Techfest 17 1991 p 23 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18026# Wichita State Univ., KS. Dept. of Mechanical Engineering.
EXPERIMENTAL STUDY OF INLET LIPS DESIGNED TO CREATE A UNIFORM EXIT VELOCITY PROFILE Abstract Only
Paul O. Steranka, Jr. and Abdul S. Tohmaz *In its* Proceedings: Techfest 17 1991 p 25 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18076# Aeronautical Systems Div., Wright-Patterson AFB, OH. Systems Program Office.
C-17 PILOTED COCKPIT TESTING
William G. Heckathorn *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18082# De Havilland Aircraft Co. of Canada Ltd., Downsview (Ontario). Powered Lift Technology Div.
THE DEVELOPMENT OF VERY THICK MULTI-FOIL WINGS FOR HIGH SPEED, POWERED LIFT TRANSPORT AIRCRAFT APPLICATIONS
J. E. Farbridge *In* AGARD, Progress in Military Airlift Dec. 1990 20 p Sponsored in part by Department of National

Defence, Ottawa, Ontario and Department of Industry, Ottawa, Ontario (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18084# Military Airlift Command, Scott AFB, IL.
C-130 REAR VISION DEVICE (BUBBLE)
Mark Julicher *In* AGARD, Progress in Military Airlift Dec. 1990 5 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18085# Wright Research Development Center, Wright-Patterson AFB, OH. Technology Exploitation Directorate.
TECHNOLOGY AND DESIGN CONSIDERATIONS FOR AN ADVANCED THEATER TRANSPORT
Richard V. Wible *In* AGARD, Progress in Military Airlift Dec. 1990 11 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18087# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Fixed Wing Engineering Section.
PROBLEMS IN CONVERTING CIVIL AIRCRAFT TO THE MILITARY TANKER ROLE
R. J. Kilford *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18088# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
C 160-TRANSALL LIFE TIME EXTENSION
Hartmut Griem *In* AGARD, Progress in Military Airlift Dec. 1990 13 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18089# Lockheed Aeronautical Systems Co., Palmdale, CA.
THE HIGH TECHNOLOGY TEST BED: A RESEARCH PROGRAMME FOR TECHNOLOGY DEVELOPMENT
C. B. Payne *In* AGARD, Progress in Military Airlift Dec. 1990 14 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18090# Douglas Aircraft Co., Inc., Long Beach, CA.
THE C-17: MODERN AIRLIFTER REQUIREMENTS AND CAPABILITIES
Leonard R. Tavernetti *In* AGARD, Progress in Military Airlift Dec. 1990 10 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18151*# Rensselaer Polytechnic Inst., Troy, NY.
INVESTIGATIONS INTO A POTENTIAL LASER-NASP TRANSPORT TECHNOLOGY Final Report, 1989 - 1990
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 195-202 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18160*# Auburn Univ., AL.
SUMMARY OF 1989 - 1990 AERONAUTICS DESIGN PROJECTS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 267-271 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18162*# California State Polytechnic Univ., Pomona.
HIGH ALTITUDE RECONNAISSANCE AIRCRAFT
Renee Anna Yazdo and David Moller *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 275-282 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18163*# California Polytechnic State Univ., San Luis Obispo.
THE CALIFORNIA CORRIDOR TRANSPORTATION SYSTEM: A DESIGN SUMMARY
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 283-286 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18164*# Case Western Reserve Univ., Cleveland, OH.
O-THREE: A HIGH ALTITUDE, REMOTELY PILOTED VEHICLE
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 287-290 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18165*# Kansas Univ., Lawrence.
PRELIMINARY DESIGN OF A SUPERSONIC SHORT-TAKEOFF AND VERTICAL-LANDING (STOVL) FIGHTER AIRCRAFT
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 291-300 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18166*# Notre Dame Univ., IN.
DESIGN OF A REMOTELY PILOTED VEHICLE FOR A LOW REYNOLDS NUMBER STATION KEEPING MISSION
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 301-308 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18167*# Ohio State Univ., Columbus.
A HYPERSONIC RESEARCH VEHICLE TO DEVELOP SCRAMJET ENGINES
G. M. Gregorek and R. L. Reuss *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 309-317 Previously announced in IAA as A90-49115 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18168*# Ecole Polytechnique Feminine, Sceaux (France).
CARRIER AIRCRAFT Abstract Only
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 319 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18169*# Purdue Univ., West Lafayette, IN.
DESIGN OF A HIGH SPEED BUSINESS TRANSPORT
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 321-324 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

N91-18170*# Worcester Polytechnic Inst., MA.
HIGH ALTITUDE, MICROWAVE-POWERED ATMOSPHERIC SAMPLING AIRCRAFT Abstract Only
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 325 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N91-18109# Federal Aviation Administration, Atlantic City, NJ.
REPORT OF STUDY ON AIRLINES' ANTICIPATED NEAR FUTURE COCKPIT CONTROL AND DISPLAY CAPABILITIES AND PLANS FOR DATA LINK COMMUNICATION Technical Report, Jan. 1991
Michael A. Pomykacz (Computer Technology Associates, Inc., McKee City, NJ.) Feb. 1991 36 p
(Contract T2003C)
(DOT/FAA/CT-TN91/7) Avail: NTIS HC/MF A03

The findings of a study conducted by CTA Incorporated for the Federal Aviation Administration Technical Center, Airborne Data Link Program are reviewed. For each of seven airlines, the following was studied for their anticipated near future fleets: (1) the quantity of each aircraft model; (2) the cockpit control and display devices that would be onboard each aircraft model; (3) choice of device for the primary data link display; and (4) choice of annunciation form to use. These data were then compiled to determine the total studied fleet's capabilities, as well as their plans for displaying data link information. Author

N91-18073# Military Airlift Command, Scott AFB, IL. Reliability and Maintainability Technology Div.
C-130 ELECTRONIC COCKPIT: RELIABILITY AND MAINTAINABILITY TECHNOLOGY INSERTION PROGRAM (RAMTIP)
Robert L. Russell *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N91-18110# Aeronautical Research Labs., Melbourne (Australia).
DESIGN AND PRELIMINARY DEVELOPMENT OF AN ENGINE FOR SMALL UNMANNED AIR VEHICLES
B. G. Catchpole and B. Parmington Aug. 1990 51 p Original contains color illustrations
(ARL-PROP-R-184; AR-006-093) Copyright Avail: NTIS HC/MF A04; 2 functional color pages

A program is described of the advantages obtained from the opposed piston two stroke engine for use in small, propeller driven, unmanned air vehicles requiring power of about 10 to 20 kW. Analysis of the requirements for engines for this duty showed the opposed piston configuration as offering the best compromise in terms of specific output, specific fuel consumption, level of vibration, and complexity. Initial feasibility was shown using a small engine of 67 mL swept volume. The major part of the development, including selection and development of a scavenge air compressor, was carried out using an engine of 225 mL swept volume. The maximum power obtained was 18.9 kW (25 HP) at 7500 rpm. Considerations involved in the selection of the configuration are discussed. The development of the rig engine and of the scavenge air blower is described and details of the performance are given. Factors limiting the performance and the potential for increased output and improved economy are outlined. The initial feasibility of a more radical design, with the connecting rods and crankshafts replaced by a system of cams and rollers, was also shown by making and running an engine. Results are also given. Author

N91-18111# Argonne National Lab., IL. Energy Systems Div.
COPPER CONTAMINATION EFFECTS ON HYDROGEN-AIR COMBUSTION UNDER SCRAMJET (SUPERSONIC COMBUSTION RAMJET) TESTING CONDITIONS
S. L. Chang, S. A. Lottes, and G. F. Berry 1990 11 p Presented at the 27th JANNAF Combustion Meeting, Cheyenne, WY, 5-9 Nov. 1990
(Contract W-31-109-eng-38; AF-AFOSR-0009-88)
(DE91-006545; CONF-9011119-3) Avail: NTIS HC/MF A03

Two forms of copper catalytic reactions (homogeneous and heterogeneous) in hydrogen flames were found in a literature survey. Hydrogen atoms in flames recombine into hydrogen molecules through catalytic reactions, and these reactions which affect the timing of the combustion process. Simulations of hydrogen flames with copper contamination were conducted by using a modified general chemical kinetics program (GCKP). Results show that reaction times of hydrogen flames are shortened by copper catalytic reactions, but ignition times are relatively insensitive to the reactions. The reduction of reaction time depends on the copper concentration, copper phase, particle size (if copper is in the condensed phase), and initial temperature and pressure. The higher the copper concentration of the smaller the particle, the larger the reduction in reaction time. For a supersonic hydrogen flame (Mach number = 4.4) contaminated with 200 ppm of gaseous copper species, the calculated reaction times are reduced by about 9 percent. Similar reductions in reaction time are also computed for heterogeneous copper contamination. Under scramjet testing conditions, the change of combustion timing appears to be tolerable (less than 5 percent) if the Mach number is lower than 3 or the copper contamination is less than 100 ppm. The higher rate the Mach number, the longer the reaction time and the larger the copper catalytic effects. DOE

N91-18112# Federal Aviation Administration, Atlantic City, NJ.
STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1987 Final Report
R. A. DeLucia (Naval Air Propulsion Test Center, Trenton, NJ.), B. C. Fenton, and Janine Blake Jan. 1991 28 p
(Contract DOD/FA7INA-AP-98)
(DOT/FAA/CT-90/19; NAPC-PE-188) Avail: NTIS HC/MF A03

Statistical information relating to gas turbine engine rotor failures which occurred during 1987 in U.S. commercial aviation service use is presented. Three hundred thirty-two failures occurred in 1987. Rotor fragments were generated in 170 of the failures, and of these 12 were uncontained. The predominant failure involved blade fragments, 95 percent of which were contained. Four disk failures occurred and all were uncontained. Forty-nine percent of the 332 failures occurred during the takeoff and climb stages of flight. This service data analysis is prepared on a calendar year basis and published yearly. The data are useful in support of flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses. Author

N91-18113# Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Flugantriebe.
EXPERIMENTAL PARAMETER DETERMINATION AND SYSTEMS ANALYSIS FOR HELICOPTER GAS TURBINE Ph.D. Thesis [EXPERIMENTELLE KENNWERTERMITTLUNG UND SYSTEMANALYSE BEI HUBSCHRAUBER-GASTURBINEN]
Martin Menrath 1989 203 p In GERMAN
(ETN-91-98798) Avail: NTIS HC/MF A10

A computerized shaft horsepower gas turbine test stand was built. The total measuring system was statistically and dynamically calibrated in separated tests, in order to assess the dependability of identified parameters. Dynamic measuring errors were compensated by corresponding equalizing networks, prior to the evaluation of unsteady measurements. The characteristics of the stationary behavior were obtained with a non parametric model

for the total working capacity of the gas turbine. The characteristics of the gas generator were easily obtained with a high degree of accuracy. It was shown that a heat model is to be considered for the identification of the compressor outlet temperature. ESA

N91-18114# Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Metallurgie und Metallkunde.
EFFECT OF CORROSION PROTECTIVE COATINGS ON COMPRESSION TURBINE BLADES FOLLOWING DIFFERENT EROSION STRESSES Ph.D. Thesis [WIRKUNG VON KORROSIONSSCHUTZUEBERZUEGEN AUF VERDICHTERLAUFSCHAUFELN NACH UNTERSCHIEDLICHEN EROSIONSBEANSPRUCHUNGEN]
Thomas W. Happle 1989 172 p In GERMAN Sponsored by BMFT
(ETN-91-98800) Avail: NTIS HC/MF A08

Detailed investigations of inorganic bonded aluminum coatings were performed. These coatings were classified according to their basic corrosion and erosion behaviors. The vibration fracturing corrosion behavior of aluminum coatings was determined for undamaged and eroded state. The test methods were adapted to the complex operating loads of compressor blades. A practice conformed erosion test process was developed. ESA

N91-18080# British Aerospace Aircraft Group, Woodford (England). Airlines Div.
THE POWERPLANT OPTIONS FOR A FUTURE LARGE AIRCRAFT
D. G. Spencer and R. S. Clough *In* AGARD, Progress in Military Airlift Dec. 1990 13 p Prepared in cooperation with Rolls-Royce Ltd., Derby, England (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N91-18115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CANDIDATE CONTROL DESIGN METRICS FOR AN AGILE FIGHTER
Patrick C. Murphy, Melvin L. Bailey (Lockheed Engineering and Sciences Co., Hampton, VA.), and Aaron J. Ostroff Washington Mar. 1991 64 p
(NASA-TM-4238; L-16766; NAS 1.15:4238) Avail: NTIS HC/MF A04 CSCL 01C

Success in the fighter combat environment of the future will certainly demand increasing capability from aircraft technology. These advanced capabilities in the form of superagility and supermaneuverability will require special design techniques which translate advanced air combat maneuvering requirements into design criteria. Control design metrics can provide some of these techniques for the control designer. Thus study presents an overview of control design metrics and investigates metrics for advanced fighter agility. The objectives of various metric users, such as airframe designers and pilots, are differentiated from the objectives of the control designer. Using an advanced fighter model, metric values are documented over a portion of the flight envelope through piloted simulation. These metric values provide a baseline against which future control system improvements can be compared and against which a control design methodology can be developed. Agility is measured for axial, pitch, and roll axes. Axial metrics highlight acceleration and deceleration capabilities under different flight loads and include specific excess power measurements to characterize energy meneuverability. Pitch metrics cover both body-axis and wind-axis pitch rates and accelerations. Included in pitch metrics are nose pointing metrics which highlight displacement capability between the nose and the velocity vector. Roll metrics (or torsion metrics) focus on rotational capability about the wind axis. Author

N91-18116*# Boeing Co., Seattle, WA.
PERSONNEL LAUNCH SYSTEM AUTOLAND DEVELOPMENT STUDY Final Report
J. A. Bossi, M. A. Langehough, and J. C. Tollefson Jan. 1991 168 p
(Contract NAS1-18762)
(NASA-CR-187495; NAS 1.26:187495) Avail: NTIS HC/MF A08 CSCL 01C

The Personnel Launch System (PLS) Autoland Development Study focused on development of the guidance and control system for the approach and landing (A/L) phase and the terminal area energy management (TAEM) phase. In the A/L phase, a straight-in trajectory profile was developed with an initial high glide slope, a pull-up and flare to lower glide slope, and the final flare touchdown. The TAEM system consisted of using a heading alignment cone spiral profile. The PLS autopilot was developed using integral LQG design techniques. The guidance and control design was verified using a nonlinear 6 DOF simulation. Simulation results demonstrated accurate steering during the TAEM phase and adequate autoland performance in the presence of wind turbulence and wind shear. Author

N91-18117# National Aeronautical Lab., Bangalore (India).
PRECISION MECHANICS OF ACTUATORS IN AIRCRAFT AND ROCKETS
P. T. Varute Sep. 1990 114 p
(NAL-SP-9016) Avail: NTIS HC/MF A06

A lecture series is presented which is spread over the following six areas: (1) types of actuators; (2) the study and design of actuators; (3) basic requirements in actuator dynamic performance; (4) development and fabrication technology of actuators; (5) state-of-the-art in actuators; and (6) equipment and instruments required for development and testing of servo actuators in a laboratory. Author

N91-18118# Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Flugmechanik und Flugregelung.
ELASTIC AIRPLANE GUST RESPONSE Ph.D. Thesis [ZUM BOEENVERHALTEN ELASTISCHER FLUGZEUGE]
Johann Krammer 1989 151 p In GERMAN
(ETN-91-98797) Avail: NTIS HC/MF A08

A new mathematical model for elastic airplane gust response, including measured or calculated natural oscillation magnitude, is presented. An airfoil process extended to an oscillating deflection system is used, in order to describe the unsteady aerodynamic forces, out of proper motion and gust disturbances. This system is proved advantageous, in relation to computation time and storage location need, on account of the partial analytical integration carried out. The frequency dependent loads were discussed for two airplanes, for harmonic gust disturbances and stochastic one and two dimensional turbulence models, in order to explain the performance of the model. ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N91-18119# National Aeronautical Lab., Bangalore (India). Flight Mechanics and Controls Div.
DYNAMIC WIND TUNNEL TESTING OF A FLEXIBLE WING MODEL
M. S. Rajamurthy and S. Balakrishna Oct. 1990 25 p Original

contains color illustrations
(NAL-PD-FC-9010) Avail: NTIS HC/MF A03; 2 functional color pages

The current state-of-the-art in the design of modern combat aircraft is to use CCV (Control Configured Vehicles) concepts to obtain high performance at lower weight. This demands an unstable aerodynamic configuration with the stability provided artificially by the control system. This needs longitudinal servo-actuators of high bandwidth. With lower structural frequencies there is scope for interaction and aeroservoelastic problems could occur. A simple experimental study of servoelastically exciting wing to yield transfer function data is detailed. The aim of these experiments is to provide a vehicle for generating experimental data for validating aeroservoelastic codes and to obtain insight of flutter/aeroservo-elastic phenomena through scaled models. Author

N91-18120*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MECHANICAL PROPERTIES OF THE FIBERGLASS PREPREG SYSTEM USED FOR THE NATIONAL TRANSONIC FACILITY REPLACEMENT BLADE SET Technical Report, 1989 - 1990
Clarence P. Young, Jr. and John W. Wallace Feb. 1991 26 p
(NASA-TM-102756; NAS 1.15:102756) Avail: NTIS HC/MF A03 CSCL 14B

The results are presented of mechanical and physical properties characterization testing for the fiber glass prepreg system used to fabricate 15 of the replacement set of 25 fan blades for the National Transonic Facility. The fan blades were fabricated to be identical to the original blade set with the exception that the 7576 style E glass cloth used for the replacement set has a different surface finish than the original 7576 cloth. The 7781 E glass cloth and resin system were unchanged. The data are presented for elevated, room, and cryogenic temperatures. The results are compared with data from the original blade set and evaluated against selected structural design criteria. Test experience is described along with recommendations for future testing of these materials if required. Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N91-18121*# Universities Space Research Association, Houston, TX.
PROCEEDINGS OF THE 6TH ANNUAL SUMMER CONFERENCE: NASA/USRA UNIVERSITY ADVANCED DESIGN PROGRAM Final Report
Nov. 1990 319 p Conference held in Cleveland, OH, 11-15 Jun. 1990; sponsored by NASA. Lewis Research Center and USRA
(Contract NASw-4435)
(NASA-CR-187041; NAS 1.26:187041) Avail: NTIS HC/MF A14 CSCL 22A

The NASA/USRA University Advanced Design Program is a unique program that brings together NASA engineers, students, and faculty from United States engineering schools by integrating current and future NASA space/aeronautics engineering design projects into the university curriculum. The Program was conceived in the fall of 1984 as a pilot project to foster engineering design education in the universities and to supplement NASA's in-house efforts in advanced planning for space and aeronautics design. Nine universities and five NASA centers participated in the first year of the pilot project. The study topics cover a broad range of potential space and aeronautics projects that could be undertaken during a 20 to 30 year period beginning with the deployment of the Space Station Freedom scheduled for the mid-1990s. Both manned and unmanned endeavors are embraced, and the systems approach to the design problem is emphasized. For individual titles, see N91-18122 through N91-18172.

N91-18122*# Alabama Univ., Huntsville.
FLUID PHASE SEPARATION (FPS) EXPERIMENT FOR FLIGHT ON THE SHUTTLE IN A GET AWAY SPECIAL (GAS) CANISTER: DESIGN AND FABRICATION **c29**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 3-10 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

The separation of fluid phases in microgravity environments is of importance to environmental control and life support systems (ECLSS) and materials processing in space. A successful fluid phase separation experiment will demonstrate a proof of concept for the separation technique and add to the knowledge base of material behavior. The phase separation experiment will contain a premixed fluid that will be exposed to a microgravity environment. After the phase separation of the compound has occurred, small samples of each of the species will be taken for analysis on Earth. By correlating the time of separation and the temperature history of the fluid, it will be possible to characterize the process. The phase separation experiment is totally self-contained, with three levels of containment on all fluids, and provides all necessary electrical power and control. The controller regulates the temperature of the fluid and controls data logging and sampling. An astronaut-activated switch will initiate the experiment and an unmaskable interrupt is provided for shutdown. The experiment has been integrated into space available on a manifested Get Away Special (GAS) experiment, CONCAP 2, part of the Consortium for Materials Complex Autonomous Payload (CAP) Program, scheduled for STS 42 in April 1991. Presented here are the design and the production of a fluid phase separation experiment for rapid implementation at low cost. Author

N91-18123*# Arizona Univ., Tucson.
AUTONOMOUS SPACE PROCESSOR FOR ORBITAL DEBRIS **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 11-21 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

This work continues to develop advanced designs toward the ultimate goal of a Get Away Special to demonstrate economical removal of orbital debris using local resources in orbit. The fundamental technical feasibility was demonstrated in 1988 through theoretical calculations, quantitative computer animation, a solar focal point cutter, a robotic arm design, and a subscale model. Last year improvements were made to the solar cutter and the robotic arm. Also performed last year was a mission analysis that showed the feasibility of retrieving at least four large (greater than 1500-kg) pieces of debris. Advances made during this reporting period are the incorporation of digital control with the existing placement arm, the development of a new robotic manipulator arm, and the study of debris spin attenuation. These advances are discussed here. Author

N91-18124*# California Univ., Los Angeles.
LABORATORY SIMULATION OF THE ROCKET MOTOR THRUST AS A FOLLOWER FORCE **c20**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 23-26 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 21H

Ground tests of solid propellant rocket motors have shown that metal-containing propellants produce various amounts of slag (primarily aluminum oxide), which is trapped in the motor case causing a loss of specific impulse. Although not yet definitely established, the presence of a liquid pool of slag also may contribute to nutational instabilities that have been observed with certain spin-stabilized, upper-stage vehicles. Because of the rocket's axial acceleration - absent in the ground tests - estimates of in-flight slag mass have been very uncertain. Yet such estimates are needed to determine the magnitude of the control authority of the systems required for eliminating the instability. A test rig with an eccentrically mounted hemispherical bowl was designed and

built that incorporates a follower force that properly aligns the thrust vector along the axis of spin. A program that computes the motion of a point mass in the spinning and precessing bowl was written. Using various rpm, friction factors, and initial starting conditions, plots were generated showing the trace of the point mass around the inside of the fuel tank. The apparatus will be used extensively during the 1990 to 1991 academic year and incorporate future design features such as a variable nutation angle and a film height measuring instrument. Data obtained on the nutational instability characteristics will be used to determine order-of-magnitude estimates of control authority needed to minimize the sloshing effect. Author

N91-18125*# California Univ., Los Angeles.
DESIGN OF A SCIENTIFIC PROBE FOR OBTAINING MARS SURFACE MATERIAL **c91**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 27-33 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

With the recent renewed interest in interplanetary and deep space exploratory missions, the Red Planet, Mars, which has captured people's imagination for centuries, has again become a center of attention. In the late 1960s and early 1970s, a series of Mariner missions performed fly-by investigations of the Mars surface and atmosphere. Later, in the mid 1970s, the data gathered by these earlier Mariner missions provided the basis of the much-publicized Viking missions, whose main objective was to determine the possibility of extraterrestrial life on Mars. More recently, with the dramatic changes in international politics, ambitious joint manned missions between the United States and the Soviet Union have been proposed to be launched in the early 21st century. In light of these exciting developments, the Spacecraft Design course, which was newly established at UCLA under NASA/USRA sponsorship, has developed its curriculum around a design project: the synthesis of an unmanned Martian landing probe. The students are required to conceive a preliminary design of a small spacecraft that is capable of landing at a designated site, collecting soil samples, and then returning the samples to orbit. The goal of the project is to demonstrate the feasibility of such a mission. This preliminary study of an interplanetary exploration mission has shown the feasibility of such a mission. The students have learned valuable lessons about the complexity of spacecraft design, even though the mission is relatively simple. Author

N91-18126*# University of Central Florida, Orlando.
POSTLANDING OPTIMUM DESIGNS FOR THE ASSURED CREW RETURN VEHICLE **c18**
Kenneth C. Hosterman and Loren A. Anderson *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 35-39 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

The optimized preliminary engineering design concepts for postlanding operations of a water-landing Assured Crew Return Vehicle (ACRV) during a medical rescue mission are presented. Two ACRVs will be permanently docked to Space Station Freedom, fulfilling NASA's commitment to Assured Crew Return Capability in the event of an accident or illness. The optimized configuration of the ACRV is based on an Apollo command module (ACM) derivative. The scenario assumes landing a sick or injured crewmember on water with the possibility of a delayed rescue. Design emphasis is placed on four major areas. First is the design of a mechanism that provides a safe and time-critical means of removing the sick or injured crewmember from the ACRV. Support to the assisting rescue personnel is also provided. Second is the design of a system that orients and stabilizes the craft after landing so as to cause no further injury or discomfort to the already ill or injured crewmember. Third is the design of a system that provides full medical support to a sick or injured crewmember aboard the ACRV from the time of separation from the space station to rescue by recovery forces. Last is the design of a system that provides for the comfort and safety of the entire crew after splashdown up to the point of rescue. The four systems are conceptually integrated into the ACRV. Author

N91-18127*# Colorado Univ., Boulder.
METHODS FOR THE DEVELOPMENT OF A BIOREGENERATIVE LIFE SUPPORT SYSTEM **c54**
Michelle Goldman, Shawn Gomez, and Mike Voorhees *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 41-47 Sponsored by NASA, Ames Research Center (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

Presented here is a rudimentary approach to designing a life support system based on the utilization of plants and animals. The biggest stumbling block in the initial phases of developing a bioregenerative life support system is encountered in collecting and consolidating the data. If a database existed for the systems engineer so that he or she may have accurate data and a better understanding of biological systems in engineering terms, then the design process would be simplified. Also addressed is a means of evaluating the subsystems chosen. These subsystems are unified into a common metric, kilograms of mass, and normalized in relation to the throughput of a few basic elements. The initial integration of these subsystems is based on input/output masses and eventually balanced to a point of operation within the inherent performance ranges of the organisms chosen. At this point, it becomes necessary to go beyond the simplifying assumptions of simple mass relationships and further define for each organism the processes used to manipulate the throughput matter. Mainly considered here is the fact that these organisms perform input/output functions on differing timescales, thus establishing the need for buffer volumes or appropriate subsystem phasing. At each point in a systematic design it is necessary to disturb the system and discern its sensitivity to the disturbance. This can be done either through the introduction of a catastrophic failure or by applying a small perturbation to the system. One example is increasing the crew size. Here the wide range of performance characteristics once again shows that biological systems have an inherent advantage in responding to systemic perturbations. Since the design of any space-based system depends on mass, power, and volume requirements, each subsystem must be evaluated in these terms. Author

N91-18128*# Florida Univ., Gainesville.
IMPLEMENTATION OF SENSOR AND CONTROL DESIGNS FOR BIOREGENERATIVE SYSTEMS **c54**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 49-52 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

The EGM 4000/4001 Engineering Design class is an interdisciplinary design course that allows students to experience the design process. The projects involved the design of sensors and subsystems of a closed-loop life support system (CLLSS) with special emphasis on the Controlled Ecological Life Support System (CELSS) currently being developed at Kennedy Space Center (KSC) by NASA. To understand the work performed by the students, one must understand the purpose and concept of a CLLSS system. In the years to come, NASA will be constructing Moon bases and sending astronauts to other worlds on extended space missions. In order to support the crews, unreasonably large quantities of supplies would have to be sent from Earth. These supplies would be difficult to transport and require large holds. To remedy this problem, NASA plans to incorporate crops into the spacecraft. These crops would supply food for the crews, as well as provide beneficial psychological side effects. In addition, the plants would recycle the air and human waste and provide oxygen and water for the humans. The students in the design class were to work on supporting this project. In order to do this successfully, the course was separated into two phases. The first semester involved studying the various aspects of a CLLSS to determine sensing needs and develop ideas. The second semester involved

first determining which of the ideas were most promising. Specific sensors were then designed and tested under laboratory conditions with promising results. Finally, recommendations for further development were proposed. Atmosphere and temperature control, nutrient delivery, plant health and propagation, and resource recycling are discussed. Author

N91-18129*# Florida Agricultural and Mechanical Univ., Tallahassee.
CONCEPTUAL SECOND-GENERATION LUNAR EQUIPMENT **c91**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 53-54 Prepared in cooperation with Florida State Univ., Tallahassee (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

The spring 1990 Introduction to Design class was asked to conceptually design second-generation lunar vehicles and equipment as a semester design project. The basic assumption made in designing second-generation lunar vehicles and equipment was that a network of permanent lunar bases already existed. The designs were to facilitate the transportation of personnel and materials. The eight topics to choose from included flying vehicles, ground-based vehicles, robotic arms, and life support systems. Two teams of two or three members competed on each topic and results were exhibited at a formal presentation. A clean-propellant powered lunar flying transport vehicle, an extra-vehicular activity life support system, a pressurized lunar rover for greater distances, and a robotic arm design project are discussed. Author

N91-18130*# Florida Agricultural and Mechanical Univ., Tallahassee. Coll. of Engineering.
LUNAR ARTICULATED REMOTE TRANSPORTATION SYSTEM **c37**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 55-59 Prepared in cooperation with Florida State Univ., Tallahassee (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13F

The students of the Florida A&M/Florida State University College of Engineering continued their design from 1988 to 1989 on a first generation lunar transportation vehicle for use on the surface of the Moon between the years 2010 and 2020. Attention is focused on specific design details on all components of the Lunar Articulated Remote Transportation System (Lunar ARTS). The Lunar ARTS will be a three-cart, six-wheeled articulated vehicle. Its purpose will be the transportation of astronauts and/or materials for excavation purposes at a short distance from the base (37.5 km). The power system includes fuel cells for both the primary system and the back-up system. The vehicle has the option of being operated in a manned or unmanned mode. The unmanned mode includes stereo imaging with signal processing for navigation. For manned missions the display console is a digital readout displayed on the inside of the astronaut's helmet. A microprocessor is also on board the vehicle. Other components of the vehicle include a double wishbone/flexible hemispherical wheel suspension; chassis; a steering system; motors; seat restraints; heat rejection systems; solar flare protection; dust protection; and meteoroid protection. A one-quarter scale dynamic model has been built to study the dynamic behavior of the vehicle. The dynamic model closely captures the mechanical and electrical details of the total design. Author

N91-18131*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
LUNAR SURFACE VEHICLE MODEL COMPETITION **c37**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 61-62 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13F

During Fall and Winter quarters, Georgia Tech's School of Mechanical Engineering students designed machines and devices related to Lunar Base construction tasks. These include joint projects with Textile Engineering students. Topics studied included lunar environment simulator via drop tower technology, lunar rated fasteners, lunar habitat shelter, design of a lunar surface trenching machine, lunar support system, lunar worksite illumination (daytime), lunar regolith bagging system, sunlight diffusing tent for lunar worksite, service apparatus for lunar launch vehicles, lunar communication/power cables and teleoperated deployment machine, lunar regolith bag collection and emplacement device, soil stabilization mat for lunar launch/landing site, lunar rated fastening systems for robotic implementation, lunar surface cable/conduit and automated deployment system, lunar regolith bagging system, and lunar rated fasteners and fastening systems. A special topics team of five Spring quarter students designed and constructed a remotely controlled crane implement for the SKITTER model. Author

N91-18132*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
BAGGING SYSTEM, SOIL STABILIZATION MAT, AND TENT FRAME FOR A LUNAR BASE **c31**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 63-67 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

Georgia Tech's School of Textile and Fiber Engineering and School of Mechanical Engineering participated in four cooperative design efforts this year. Each of two interdisciplinary teams designed a system consisting of a lunar regolith bag and an apparatus for filling this bag. The third group designed a mat for stabilization of lunar soil during takeoff and landing, and a method for packaging and deploying this mat. Finally, the fourth group designed a sunlight diffusing tent to be used as a lunar worksite. Summaries of these projects are given. Author

N91-18133*# Houston Univ., TX. Coll. of Architecture.
SPACEPORT AURORA: AN ORBITING TRANSPORTATION NODE **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 69-78 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

With recent announcements of the development of permanently staffed facilities on the Moon and Mars, the national space plan is in need of an infrastructure system for transportation and maintenance. A project team at the University of Houston College of Architecture and the Sasakawa International Center for Space Architecture, recently examined components for a low Earth orbit (LEO) transportation node that supports a lunar build-up scenario. Areas of investigation included identifying transportation node functions, identifying existing space systems and subsystems, analyzing variable orbits, determining logistics strategies for maintenance, and investigating assured crew return systems. The information resulted in a requirements definition document, from which the team then addressed conceptual designs for a LEO transportation node. The primary design drivers included: orbital stability, maximizing human performance and safety, vehicle maintainability, and modularity within existing space infrastructure. For orbital stability, the power tower configuration provides a gravity gradient stabilized facility and serves as the backbone for the various facility components. To maximize human performance, human comfort is stressed through zoning of living and working activities, maintaining a consistent local vertical orientation, providing crew interaction and viewing areas and providing crew return vehicles. Vehicle maintainability is accomplished through dual hangars, dual work cupolas, work modules, telerobotics and a fuel depot. Modularity is incorporated using Space Station Freedom module diameter, Space Station Freedom standard racks, and interchangeable interior partitions. It is intended that the final design be flexible and adaptable to provide a facility prototype that can service multiple mission profiles using modular space systems. Author

N91-18134*# Houston Univ., TX. Coll. of Architecture.
IN-SITU RESOURCE UTILIZATION IN THE DESIGN OF ADVANCED LUNAR FACILITIES **c91**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 79-87 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

Resource utilization will play an important role in the establishment and support of a permanently manned lunar base. At the University of Houston - College of Architecture and the Sasakawa International Center for Space Architecture, a study team recently investigated the potential use of lunar in-situ materials in the design of lunar facilities. The team identified seven potential lunar construction materials; concrete, sulfur concrete, cast basalt, sintered basalt, glass, fiberglass, and metals. Analysis and evaluation of these materials with respect to their physical properties, processes, energy requirements, resource efficiency, and overall advantages and disadvantages lead to the selection of basalt materials as the more likely construction material for initial use on a lunar base. Basalt materials can be formed out of in-situ lunar regolith, with minor material beneficiation, by a simple process of heating and controlled cooling. The team then conceptualized a construction system that combines lunar regolith sintering and casting to make pressurized structures out of lunar resources. The design uses a machine that simultaneously excavates and sinters the lunar regolith to create a cylindrical hole, which is then enclosed with cast basalt slabs, allowing the volume to be pressurized for use as a living or work environment. Cylinder depths of up to 4 to 6 m in the lunar mare or 10 to 12 m in the lunar highlands are possible. Advantages of this construction system include maximum resource utilization, relatively large habitable volumes, interior flexibility, and minimal construction equipment needs. Conclusions of this study indicate that there is significant potential for the use of basalt, a lunar resource derived construction material, as a low cost alternative to Earth-based materials. It remains to be determined when in lunar base phasing this construction method should be implemented. Author

N91-18135*# Idaho Univ., Moscow.
PRELIMINARY GREENHOUSE DESIGN FOR A MARTIAN COLONY: STRUCTURAL, SOLAR COLLECTION, AND LIGHT DISTRIBUTION SYSTEMS **c31**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 89-92 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

The design of a greenhouse that will be a component of a long-term habitat on Mars is presented. The greenhouse will be the primary food source for people stationed on Mars. The food will be grown in three identical underground modules, pressurized at 1 atm to allow a shirt-sleeve environment within the greenhouse. The underground location will support the structure, moderate the large environmental variations on the surface, and protect the crops from cosmic radiation. The design effort is concentrated on the outer structure and the lighting system for the greenhouse. The structure is inflatable and made of a Kevlar 49/Epoxy composite and a pipe-arched system that is corrugated to increase stiffness. This composite is pliable in an uncured state, which allows it to be efficiently packaged for transport. The lighting system consists of several flat-plate fiber optic solar collectors with dual-axis tracking systems that will continually track the sun. This design is modeled after the Himawari collector, which was designed by Dr. Kei Mori and is currently in use in Japan. The light will pass through Fresnel lenses that filter out undesirable wavelengths and send the light into the greenhouses by way of fiber optic cables. When the light arrives at the greenhouse, it is dispersed to the plants via a waveguide and diffuser system. Author

N91-18136*# Illinois Univ., Urbana-Champaign.
AN UNMANNED PROBE TO PLUTO **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 93-97 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Now that Voyager II has completed its grand tour of the solar system, all the planets in the solar system, with the exception of Pluto, have been studied. Even now, missions to return to Mercury, Venus, Mars Jupiter, and Saturn are currently flying or are planned. However, a mission to explore Pluto is not, at the present time, being considered seriously. The design problem presented to the students was very general, i.e., design an unmanned mission to Pluto with a launch window constraint of the years 2000 to 2010. All other characteristics of the mission, such as mission type (flyby, orbiter, lander, penetrator), scientific objectives and payload, and the propulsion system were to be determined by the design teams. The design studies exposed several general problems to be solved. Due to the extreme distance to Pluto (and a corresponding travel time in the range of 10 to 25 years), the spacecraft had to be lighter and more robust than current spacecraft designs. In addition, advanced propulsion concepts had to be considered. These included the new generation of launch vehicles and upper stages and nuclear electric propulsion. The probe design offered an abundance of synthesis and analysis problems. These included sizing trade studies, selection of subsystem components, analysis of spacecraft dynamics, stability and control, structural design and material selection, trajectory design, and selection of scientific equipment. Since the characteristics of the mission, excluding the launch window, were to be determined by the design teams, the solutions varied widely. Author

N91-18137*# Kansas State Univ., Manhattan.
AUTOMATION OF CLOSED ENVIRONMENTS IN SPACE FOR HUMAN COMFORT AND SAFETY **c54**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 99-103 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

The Environmental Control and Life Support System (ECLSS) for the Space Station Freedom and future colonization of the Moon and Mars presents new challenges for present technologies. Current plans call for a crew of 8 to live in a safe, shirt-sleeve environment for 90 days without ground support. Because of these requirements, all life support systems must be self-sufficient and reliable. The ECLSS is composed of six subsystems. The temperature and humidity control (THC) subsystem maintains the cabin temperature and humidity at a comfortable level. The atmosphere control and supply (ACS) subsystem insures proper cabin pressure and partial pressures of oxygen and nitrogen. To protect the space station from fire damage, the fire detection and suppression (FDS) subsystem provides fire sensing alarms and extinguishers. The waste management (WM) subsystem compacts solid wastes for return to Earth, and collects urine for water recovery. Because it is impractical, if not impossible, to supply the station with enough fresh air and water for the duration of the space station's extended mission, these elements are recycled. The atmosphere revitalization (AR) subsystem removes CO2 and other dangerous contaminants from the air. The water recovery and management (WRM) subsystem collects and filters condensate from the cabin to replenish potable water supplies, and processes urine and other waste waters to replenish hygiene water supplies. These subsystems are not fully automated at this time. Furthermore, the control of these subsystems is not presently integrated; they are largely independent of one another. A fully integrated and automated ECLSS would increase astronauts' productivity and contribute to their safety and comfort. The Kansas State University Advanced Design Team is in the process of researching and designing controls for the automation of the ECLSS for Space Station Freedom and beyond. The approach chosen to solve this problem is to divide the design into three phases. The first phase is to research the ECLSS as a whole system and then concentrate efforts on the automation of a single subsystem. The AR subsystem was chosen for our focus. During the second phase, the system control process will then be applied to the AR subsystem.

Author

N91-18138*# Maryland Univ., College Park.
PROJECT EXODUS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 105-110 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

Project Exodus is an in-depth study to identify and address the basic problems of a manned mission to Mars. The most important problems concern propulsion, life support, structure, trajectory, and finance. Exodus will employ a passenger ship, cargo ship, and landing craft for the journey to Mars. These three major components of the mission design are discussed separately. Within each component the design characteristics of structures, trajectory, and propulsion are addressed. The design characteristics of life support are mentioned only in those sections requiring it. Author

N91-18139*# Maryland Univ., College Park.
MANNED MARS MISSION
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 111-116 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

Terrapin Technologies proposes a Manned Mars Mission design study. The purpose of the Manned Mars Mission is to transport ten people and a habitat with all required support systems and supplies from low Earth orbit (LEO) to the surface of Mars and, after an expedition of three months to return the personnel safely to LEO. The proposed hardware design is based on systems and components of demonstrated high capability and reliability. The mission design builds on past mission experience but incorporates innovative design approaches to achieve mission priorities. These priorities, in decreasing order of importance, are safety, reliability, minimum personnel transfer time, minimum weight, and minimum cost. The design demonstrates the feasibility and flexibility of a waverider transfer module. Information is given on how the plan meets the mission requirements. Author

N91-18140*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
WALKING ROBOT: A DESIGN PROJECT FOR UNDERGRADUATE STUDENTS **c37**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 117-122 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13I

The design and construction of the University of Maryland walking machine was completed during the 1989 to 1990 academic year. It was required that the machine be capable of completing a number of tasks including walking a straight line, turning to change direction, and manuevering over an obstacle such as a set of stairs. The machine consists of two sets of four telescoping legs that alternately support the entire structure. A gear box and crank arm assembly is connected to the leg sets to provide the power required for the translational motion of the machine. By retracting all eight legs, the robot comes to rest on a central Bigfoot support. Turning is accomplished by rotating this machine about this support. The machine can be controlled by using either a user-operated remote tether or the onboard computer for the execution of control commands. Absolute encoders are attached to all motors to provide the control computer with information regarding the status of the motors. Long and short range infrared sensors provide the computer with feedback information regarding the machine's position relative to a series of stripes and reflectors. These infrared sensors simulate how the robot might sense and gain information about the environment of Mars. Author

N91-18141*# Massachusetts Inst. of Tech., Cambridge.
PROJECT ARTEMIS
Shawn Birchenough, Denise Kato, Fred Kennedy, and David Akin
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 123-127 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

The goals of Project Artemis are designed to meet the challege of President Bush to return to the Moon, this time to stay. The first goal of the project is to establish a permanent manned base on the Moon for the purposes of scientific research and technological development. The knowledge gained from the establishment and operations of the lunar base will then be used to achieve the second goal of Project Artemis, the establishment of a manned base on the Martian surface. Throughout both phases of the program, crew safety will be the number one priority. There are four main issues that have governed the entire program: crew safety and mission success, commonality, growth potential, and costing and scheduling. These issues are discussed in more detail. Author

N91-18142*# Michigan Univ., Ann Arbor.
PROJECT EGRESS: THE DESIGN OF AN ASSURED CREW RETURN VEHICLE FOR THE SPACE STATION **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 129-135 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Keeping preliminary studies by NASA in mind, an Assured Crew Return Vehicle (ACRV) was developed. The system allows the escape of one or more crew members from Space Station Freedom in case of emergency. The design of the vehicle addresses propulsion, orbital operations, reentry, landing and recovery, power and communication, and life support. In light of recent modifications in Space Station design, Project EGRESS (Earthbound Guaranteed ReEntry from Space Station) pays particular attention to its impact on Space Station operations, interfaces and docking facilities, and maintenance needs. A water landing, medium lift vehicle was found to best satisfy project goals of simplicity and cost efficiency without sacrificing the safety and reliability requirements. With a single vehicle, one injured crew member could be returned to Earth with minimal pilot involvement. Since the craft is capable of returning up to five crew members, two such permanently docked vehicles would allow full evacuation of the Space Station. The craft could be constructed entirely with available 1990 technology and launched aboard a shuttle orbiter. Author

N91-18143*# Minnesota Univ., Minneapolis.
BICONIC CARGO RETURN VEHICLE WITH AN ADVANCED RECOVERY SYSTEM **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 137-144 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

The current space exploration initiative is focused around the development of the Space Station Freedom (SSF). Regular resupply missions must support a full crew on the station. The present mission capability of the shuttle is insufficient, making it necessary to find an alternative. One alternative is a reusable Cargo Return Vehicle (CRV). The suggested design is a biconic shaped, dry land recovery CRV with an advance recovery system (ARC). A liquid rocket booster will insert the CRV into a low Earth orbit. Three onboard liquid hydrogen/liquid oxygen engines are used to reach the orbit of the station. The CRV will dock to the station and cargo exchange will take place. Within the command and control zone (CCZ), the CRV will be controlled by a gaseous nitrogen reaction control system (RCS). The CRV will have the capability to exchange the payload with the Orbital Maneuvering Vehicle (OMV). The bent biconic shape will give the CRV sufficient crossrange to reach Edwards Air Force Base and several alternative sites. Near the landing site, a parafoil-shaped ARS is deployed. The CRV is designed to carry a payload of 40 klb, and has an unloaded weight of 35 klb. Author

N91-18144*# Minnesota Univ., Minneapolis.
WINGED CARGO RETURN VEHICLE CONCEPTUAL DESIGN **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990

p 145-151 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

NASA is committed to placing a permanent space station in Earth orbit in the 1990's. Space Station Freedom (SSF) will be located in a 220 n.m. orbit at 28.5 degrees inclination. The Winged Cargo Return Vehicle's (CRV) primary mission is to support SSF crew by flying regular resupply missions. The winged CRV is designed to be reusable, dry land recoverable, and unmanned. The CRV will be launched inline on three liquid hydrogen/oxygen rocket boosters with a payload capacity of 113,000 lbs. The three boosters will take the CRV to an orbit of 50 by 110 n.m. From this altitude the orbital manuevering engine will place the vehicle in synchronous orbit with the space station. The winged CRV will deliver cargo modules to the space station by direct docking or by remaining outside the SSF command zone and using the Orbital Maneuvering Vehicle (OMV) to transfer cargo. After unloading/loading, the CRV will deorbit and fly back to Kennedy Space Center. The CRV has a wing span of 57.8 feet, a length of 76.0 feet, and a dry weight of 61.5 klb. The cargo capacity of the vehicle is 44.4 klb. The vehicle has a lift-drag ratio of 1.28 (hypersonic) and 6.0 (subsonic), resulting in a 1351 n.m. cross range. The overall mission length ranges between 18.8 and 80.5 hr. The operational period will be the years 2000 to 2020.

Author

N91-18145*# Naval Postgraduate School, Monterey, CA.
HIGH-LATITUDE COMMUNICATIONS SATELLITE (HILACS) **c32**

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 153-163 Sponsored in part by JPL and NRL (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 17B

The Naval Postgraduate School in the AE 4871 Advanced Spacecraft Design course designed a communications satellite (HILACS) that will provide a continuous UHF communications link between stations located north of the region covered by geosynchronous communications satellites. The communications payload will operate only for that portion of the orbit necessary to provide specific coverage. The satellite orbit is elliptic with perigee at 1204 km in the Southern Hemisphere and an apogee at 14,930 km with 63.4 degrees inclination. Analysis and design of each of the subsystems was done to the extent possible within the constraints of an eleven week quarter and the design and analysis tools available. Work was completed in orbital analysis, the reaction control system, attitude control subsystem, electric power subsystem, telemetry, tracking, and control, thermal control subsystem, and the structures subsystem. The design team consisted of 12 students. Additional support was provided by the Jet Propulsion Laboratory and the Naval Research Laboratory.

Author

N91-18146*# Ohio State Univ., Columbus.
PROJECT WISH: THE EMERALD CITY **c18**

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 165-168 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

When Project WISH (Wandering Interplanetary Space Harbor) was initiated as a multi-year project, several design requirements were specified. The space station must have a lifetime of at least 50 years, be autonomous and independent of Earth resources, be capable of traveling throughout the solar system within a maximum flight time of three years, and have a population of 500 to 1000 people. The purpose of the station is to provide a permanent home for space colonists and to serve as a service station for space missions. The orbital mechanics, propulsion system, vehicle dynamics and control, life support system, communication system, power system, and thermal system are discussed. Author

N91-18147*# Old Dominion Univ., Norfolk, VA.
DESIGN OF AN AUTONOMOUS LUNAR CONSTRUCTION UTILITY VEHICLE **c37**

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 169-173 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

In order to prepare a site for a lunar base, an autonomously operated construction vehicle is necessary. Discussed here is a Lunar Construction Utility Vehicle (LCUV), which uses interchangeable construction implements. Design of an elastic loop track system has advanced to the testing stage. A standard coupling device has been designed to insure a proper connection between the different construction tools and the LCUV. Autonomous control of the track drive motors was simulated successfully through the use of a joystick and a computer interface. A study of hydrogen-oxygen fuel cells produced estimates of reactant and product requirements and identified multilayer insulation needs. Research on the 100-kW heat rejection system determined that it is necessary to transport the radiator panel on a utility trailer. Extensive logistical support for the 720 hour use cycle requires further study. Author

N91-18148*# Pennsylvania State Univ., University Park.
PRELIMINARY SUBSYSTEM DESIGNS FOR THE ASSURED CREW RETURN VEHICLE (ACRV) **c18**

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 175-181 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Described herein is a series of design studies concerning the Assured Crew Return Vehicle (ACRV). Study topics include a braking and landing system for the ACRV, ACRV growth options, and the design impacts of ACRV's role as a medical emergency vehicle. Four alternate designs are presented for the ACRV braking and landing system. Options presented include ballistic and lifting body reentries; the use of high-lift, high-payload aerodynamic decelerators, as well as conventional parachutes; landing systems designed for water landings, land landings or both; and an aerial recovery system. Uses of the ACRV or a similarly designed vehicle in several roles for possible future space missions are discussed, along with the required changes to the ACRV to allow it to perform these missions optimally. The impacts on the design of the ACRV due to its role as an emergency vehicle were studied and are presented here. This study included the design of a stretcher-like system to transport an ill or injured crewmember safely within the ACRV; a compilation of necessary medical equipment and decisions on how or where to store it; and recommendations about internal and external vehicle characteristics that will ease the transport of the ill or injured crewmember and allow for swift and easy ingress/egress of the vehicle. Author

N91-18149*# Prairie View Agricultural and Mechanical Coll., TX.
REPLENISHABLE FOOD SUPPLY ON MARS **c31**

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 183-186 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

The design team's present objective is to design a facility which will provide an environment to grow plants on the surface of Mars for a continuous supply of food for a ten-man crew. The main focus of the project is the design of a greenhouse. Concentration of the current design effort is on the outer structure, internal layout, and construction methods. The project was conducted by undergraduate students at Prairie View A&M University during Fall 1989 and Spring 1990. Author

N91-18150*# Puerto Rico Univ., Rio Piedras. School of Architecture.
HABITABILITY: CAMELOT 4 **c54**
W. Alequin, A. Barragan, M. Carro, F. Garcia, I. Gonzalez, J. A. Mercado, N. Negron, D. Lopez, L. A. Rivera, and M. Rivera et al

In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 187-193 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

During 1988 to 1989 the NASA/USRA Advanced Design Program sponsored research and design efforts aimed at developing habitability criteria and at defining a habitability concept as a useful tool in understanding and evaluating dwellings for prolonged stays in extraterrestrial space. The Circulating Auto sufficient Mars-Earth Luxurious Orbital Transport (CAMELOT) was studied as a case in which the students would try to enhance the quality of life of the inhabitants by applying architectural design methodology. The study proposed 14 habitability criteria considered necessary to fulfill the defined habitability concept, which is that state of equilibrium that results from the interaction between components of the Individual Architecture Mission Complex, which allows a person to sustain physiological homeostatis, adequate performance, and acceptable social relationships. Architecture, design development, refinements and revisions to improve the quality of life, new insights on artificial gravity, form and constitution problems, and the final design concept are covered. Author

N91-18151*# Rensselaer Polytechnic Inst., Troy, NY.
INVESTIGATIONS INTO A POTENTIAL LASER-NASP TRANSPORT TECHNOLOGY Final Report, 1989 - 1990 **c05**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 195-202 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

Laser propelled flight/transport technology is surveyed. A detailed conceptual design is presented for an on-place Mercury-Lightcraft: other designs are briefly explored for larger, 15-place Executive Lightcraft, and 150 to 350 passenger Jumbo Lightcraft. Author

N91-18152*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
PROJECT SUMMARIES, 1989 - 1990 **c99**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 203-208 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

Student designs summarized here include two undergraduate space designs and five graduate space designs from fall 1989, plus four undergraduate space designs and four undergraduate aircraft designs from spring 1990. Progress in a number of programs is described. The Geostationary Satellite Servicing Facility, the Lunar Farside Observatory and Science Base, the Texas Educational Satellite, an asteroid rendezvous vehicle, a Titan probe, a subsystems commonality assessment for lunar/Mars landers, a nuclear-thermal rocket propelled Earth-Mars vehicle, and a comprehensive orbital debris management program are among the topics discussed. Author

N91-18153*# Texas Univ., Austin.
PROJECT SUMMARIES **c99**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 209-212 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 05A

Lunar base projects, including a reconfigurable lunar cargo launcher, a thermal and micrometeorite protection system, a versatile lifting machine with robotic capabilities, a cargo transport system, the design of a road construction system for a lunar base, and the design of a device for removing lunar dust from material surfaces, are discussed. The emphasis on the Gulf of Mexico project was on the development of a computer simulation model for predicting vessel station keeping requirements. An existing code, used in predicting station keeping requirements for oil drilling platforms operating in North Shore (Alaska) waters was used as a basis for the computer simulation. Modifications were made to the existing code. The input into the model consists of satellite altimeter readings and water velocity readings from buoys stationed in the Gulf of Mexico. The satellite data consists of altimeter readings (wave height) taken during the spring of 1989. The simulation model predicts water velocity and direction, and wind velocity. Author

N91-18154*# Naval Academy, Annapolis, MD.
MIMES AND GEOSHACK **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 213-216 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

It is the goal of mankind to eventually visit Mars. It would be valuable to gain scientific information about the planet. The Multiple Integrated Microspacecraft Exploration System (MIMES) is designed for that very purpose. The MIMES mission will send to Mars a spacecraft carrying five probes, each of which will decend to the Martian surface to engage in scientific experiments. There will be two types of probes, a penetrator that will embed itself in the Martian surface, and a soft lander. The probes will transmit scientific data to the carrier spacecraft, which will relay the information to Earth. Information is given on mission instrumentation and operations. Author

N91-18155*# Utah State Univ., Logan.
MICROSPACECRAFT AND EARTH OBSERVATION: ELECTRICAL FIELD (ELF) MEASUREMENT PROJECT **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 217-219 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

There is a need for an inexpensive, extensive, long-lasting global electric field measurement system (ELF). The primary performance driver of this mission is the need to measure the attitude of each spacecraft in the Earth's electric field very accurately. In addition, it is necessary to know the electric charge generated by the satellite as it crosses the magnetic field lines (E equals V times B). In order to achieve the desired global coverage, a constellation of about 50 satellites in at least 18 different orbits will be used. To reduce the cost of each satellite, off-the-shelf, proven technology will be used whenever possible. Researchers have set a limit of $500,000 per satellite. Researchers expect the program cost, including the deployment of the entire constellation, to be less than $100 million. The minimum projected mission life is five years. Author

N91-18156*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THREE ORBITAL TRANSFER VEHICLES **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 221-227 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Aerospace engineering students at the Virginia Polytechnic Institute and State University undertook three design projects under the sponsorship of the NASA/USRA Advanced Space Design Program. All three projects addressed cargo and/or crew transportation between low Earth orbit and geosynchronous Earth orbit. Project SPARC presents a preliminary design of a fully reusable, chemically powered aeroassisted vehicle for a transfer of a crew of five and a 6000 to 20000 pound payload. The ASTV project outlines a chemically powered aeroassisted configuration that uses disposable tanks and a relatively small aerobrake to realize propellant savings. The third project, LOCOST, involves a reusable, hybrid laser/chemical vehicle designed for large cargo (up to 88,200 pounds) transportation. Author

N91-18157*# Washington Univ., Seattle.
MEGAWATT SOLAR POWER SYSTEMS FOR LUNAR SURFACE OPERATIONS **c44**
B. Adams, S. Alhadeff, S. Beard, D. Carlile, D. Cook, C. Douglas, D. Garcia, D. Gillespie, R. Golingo, and D. Gonzalez et al *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 229-239 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 10A

The work presented here shows that a solar power system can provide power on the order of one megawatt to a lunar base with a fairly high specific power. The main drawback to using

solar power is still the high mass, and therefore, cost of supplying energy storage through the solar night. The use of cryogenic reactant storage in a fuel cell system, however, greatly reduces the total system mass over conventional energy storage schemes. Author

N91-18158*# Wisconsin Univ., Milwaukee. Dept. of Architecture.
GENESIS LUNAR OUTPOST: AN EVOLUTIONARY LUNAR HABITAT **c54**
Gary T. Moore, comp., Dino Baschiera, Joe Fieber, and Janis Moths *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 241-254 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

Students at the University of Wisconsin-Milwaukee Department of Agriculture undertook a series of studies of lunar habitats during the 1989 to 1990 academic year. Undergraduate students from architecture and mechanical and structural engineering with backgrounds in interior design, biology and construction technology were involved in a seminar in the fall semester followed by a design studio in the spring. The studies resulted in three design alternatives for lunar habitation and an integrated design for an early stage lunar outpost. Author

N91-18159*# Worcester Polytechnic Inst., MA.
INTEGRATED SUPPORT STRUCTURE FOR GASCAN 2 **c29**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 255-264 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

The focus of the Worcester Polytechnic Institute (WPI) Advanced Space Design Program was the preliminary design of the Integrated Support Structure for GASCAN II, a Get Away Special canister donated by the MITRE Corporation. Two teams of three students each worked on the support structure. There was a structural design team and a thermal design team. The structure will carry three experiments also undergoing preliminary design this year, the mu-gravity Ignition Experiment, the Rotational Flow in Low Gravity Experiment, and the Ionospheric Properties and Propagation Experiment. The structural design team was responsible for the layout of the GASCAN and the preliminary design of the structure itself. They produced the physical interface specifications defining the baseline weights and volumes for the equipment and produced layout drawings of the system. The team produced static and modal finite element analysis of the structure using ANSYS. The thermal design team was responsible for the power and timing requirements of the payload and for the identification and preliminary analysis of potential thermal problems. The team produced the power, timing, and energy interface specifications and assisted in the development of the specification of the battery pack. The thermal parameters of each experiment were cataloged and the experiments were subjected to worst case heat transfer scenarios. Author

N91-18160*# Auburn Univ., AL.
SUMMARY OF 1989 - 1990 AERONAUTICS DESIGN PROJECTS **c05**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 267-271 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

Four design projects were completed at Auburn University this year under the sponsorship of the NASA/Universities Space Research Association Advanced Design Program. The topics discussed are the design of a high speed civil transport; the design of a 79 passenger, high efficiency, commercial transport; the design of a low cost short takeof vertical landing export fighter; and the design of an ozone monitoring vehicle. Author

N91-18161*# California State Univ., Northridge.
AUTONOMOUS MARTIAN FLYING ROVER Abstract Only **c18**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 273 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

A remotely programmable, autonomous flying rover is proposed to extensively survey the Martian surface environment. A Mach .3, solar powered, modified flying wing could cover roughly a 2000 mile range during Martian daylight hours. Multiple craft launched from an orbiting mother ship could provide near-global coverage. Each craft is envisioned to fly at about 1 km above the surface and measure atmospheric composition, pressure and temperature, map surface topography, and remotely penetrate the near subsurface looking for water (ice) and perhaps evidence of life. Data collected are relayed to Earth via the orbiting mother ship. Near surface guidance and control capability is an adaptation of current cruise missile technology. A solar powered aircraft designed to fly in the low temperature, low density, carbon dioxide Martian atmosphere near the surface appears feasible. Author

N91-18162*# California State Polytechnic Univ., Pomona.
HIGH ALTITUDE RECONNAISSANCE AIRCRAFT **c05**
Renee Anna Yazdo and David Moller *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 275-282 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

At the equator the ozone layer ranges from 65,000 to 130,000 plus feet, which is beyond the capabilities of the ER-2, NASA's current high altitude reconnaissance aircraft. The Universities Space Research Association, in cooperation with NASA, is sponsoring an undergraduate program which is geared to designing an aircraft that can study the ozone layer at the equator. This aircraft must be able to cruise at 130,000 feet for six hours at Mach 0.7, while carrying 3,000 lbs. of payload. In addition, the aircraft must have a minimum range of 6,000 miles. In consideration of the novel nature of this project, the pilot must be able to take control in the event of unforeseen difficulties. Three aircraft configurations were determined to be the most suitable - a joined-wing, a biplane, and a twin-boom conventional airplane. The performance of each configuration was analyzed to investigate the feasibility of the project. Author

N91-18163*# California Polytechnic State Univ., San Luis Obispo.
THE CALIFORNIA CORRIDOR TRANSPORTATION SYSTEM: A DESIGN SUMMARY **c05**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 283-286 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

A design group was assembled to find and research criteria relevent to the design of a California Corridor Transportation System. The efforts of this group included defining the problem, conducting a market analysis, formulation of a demand model, identification and evaluation of design drivers, and the systematic development of a solution. The problems of the current system were analyzed and used to determine design drivers, which were divided into the broad categories of cost, convenience, feasibility, environment, safety, and social impact. The relative importance of individual problems was addressed, resulting in a hierarchy of design drivers. Where possible, methods of evaluating the relative merit of proposed systems with respect to each driver were developed. Short takeoff vertical landing aircraft concepts are also discussed for supersonic fighters. Author

N91-18164*# Case Western Reserve Univ., Cleveland, OH.
O-THREE: A HIGH ALTITUDE, REMOTELY PILOTED VEHICLE **c05**
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 287-290 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

A conceptual design for a remotely piloted vehicle to be used

for ozone research above 80,000 feet was developed as part of the one-semester NASA/Universities Space Research Association Aerospace Design course at Case Western Reserve University in Fall 1989. The O-Three design team chose as its mission requirements a cruise altitude of 100,000 ft, a range of 1000 n.m., an endurance of 6 hrs., a 1000 lb payload, and a power to payload of 2 kW. These are based on the Boeing requirements for an ozone research vehicle. In addition, the vehicle should not be restricted to operation over any particular global location. Efforts were made to minimize atmospheric contamination that might increase the rate of ozone depletion and cause discrepancies in data accuracy. Design was not limited to today's level of technology. The design team was divided into four groups: aerodynamics, structures, stability, and control. The specifications and performance estimates for cruise at altitude are given in tabular form. Author

N91-18165*# Kansas Univ., Lawrence.
PRELIMINARY DESIGN OF A SUPERSONIC SHORT-TAKEOFF AND VERTICAL-LANDING (STOVL) FIGHTER AIRCRAFT c05
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 291-300 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

A preliminary study of a supersonic short takeoff and vertical landing (STOVL) fighter is presented. Three configurations (a lift plus lift/cruise concept, a hybrid fan vectored thrust concept, and a mixed flow vectored thrust concept) were initially investigated with one configuration selected for further design analysis. The selected configuration, the lift plus lift/cruise concept, was successfully integrated to accommodate the powered lift short takeoff and vertical landing requirements as well as the demanding supersonic cruise and point performance requirements. A supersonic fighter aircraft with a short takeoff and vertical landing capability using the lift plus lift/cruise engine concept seems a viable option for the next generation fighter. Author

N91-18166*# Notre Dame Univ., IN.
DESIGN OF A REMOTELY PILOTED VEHICLE FOR A LOW REYNOLDS NUMBER STATION KEEPING MISSION c05
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 301-308 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

Six teams of senior level Aerospace Engineering undergraduates were given a request for proposal, asking for a design concept for a remotely piloted vehicle (RPV). This RPV was to be designed to fly at a target Reynolds number of 1 times 10(exp 5). The craft was to maximize loiter time and perform an indoor, closed course flight. As part of the proposal, each team was required to construct a prototype and validate their design with a flight demonstration. Author

N91-18167*# Ohio State Univ., Columbus.
A HYPERSONIC RESEARCH VEHICLE TO DEVELOP SCRAMJET ENGINES c05
G. M. Gregorek and R. L. Reuss *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 309-317 Previously announced in IAA as A90-49115 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

Four student design teams produced conceptual designs for a research vehicle to develop the supersonic combustion ramjet (scramjet) engines necessary for efficient hypersonic flight. This research aircraft would provide flight test data for prototype scramjets that is not available in groundbased test facilities. The design specifications call for a research aircraft to be launched from a carrier aircraft at 40,000 feet and a Mach number of 0.8. The aircraft must accelerate to Mach 6 while climbing to a 100,000 foot altitude and then ignite the experimental scramjet engines for acceleration to Mach 10. The research vehicle must then be recovered for another flight. The students responded with four different designs, two piloted waverider configurations, and two unmanned vehicles, one with a blended body-wing configuration, the other with a delta wing shape. All aircraft made use of an engine database provided by the General Electric Aircraft Engine Group; both turbofan ramjet and scramjet engine performance using liquid hydrogen fuel was available. Explained here are the students' conceptual designs and the aerodynamic and propulsion concepts that made their designs feasible. Author

N91-18168*# Ecole Polytechnique Feminine, Sceaux (France).
CARRIER AIRCRAFT Abstract Only c05
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 319 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

The Ohio State University planned to conduct a conceptual design of a single research vehicle that could be used to explore the flight regime from Mach 6 to Mach 12. Since this aircraft will be a special purpose vehicle, it need not take off and land in a conventional manner. Indeed, if this aircraft were launched from a larger aircraft that carried it to altitude, then conventional landing gear would not be needed and the extra weight of the fuel needed to take off and climb into the stratosphere would be eliminated. The focus of the students' project was on the design of a carrier aircraft answering to the specifications. Its mission is to take off with the research aircraft from runways of less than 15,000 feet, climb to 40,000 feet, and release the hypersonic aircraft at the speed of Mach 8, and return to base. The range of this mission is 2000 n.m. This study includes the conception of an optimized aircraft (geometry, weights, propulsion, aerodynamics, interactions between the two aircraft, etc.), the longitudinal stability of the composite, and the separation critical phase. Author

N91-18169*# Purdue Univ., West Lafayette, IN.
DESIGN OF A HIGH SPEED BUSINESS TRANSPORT c05
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 321-324 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

The design of a High Speed Business Transport (HSBT) was considered by the Aeronautical Design Class during the academic year 1989 to 1990. The project was chosen to offer an opportunity to develop user friendliness for some computer codes such as WAVE DRAG, supplied by NASA/Langley, and to experiment with several design lessons developed by Dr. John McMasters and his colleages at Boeing. Central to these design lessons was an appeal to marketing and feasibility considerations. There was an emphasis upon simplified analytical techniques to study trades and to stimulate creative thinking before committing to extensive analytical activity. Two designs stood out among all the rest because of the depth of thought and consideration of alternatives. One design, the Aurora, used a fixed wing design to satisfy the design mission: the Viero used a swept wing configuration to overcome problems related to supersonic flight. A summary of each of these two designs is given. Author

N91-18170*# Worcester Polytechnic Inst., MA.
HIGH ALTITUDE, MICROWAVE-POWERED ATMOSPHERIC SAMPLING AIRCRAFT Abstract Only c05
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 325 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 01C

The preliminary design af a high altitude, remotely piloted, atmospheric sampling aircraft powered by microwave energy beamed from a ground based antenna has been completed. The aircraft utilizes a horizontal tail and a canard for longitudinal control and to enhance the structural rigidity of the twin fuselage configuration. The wing structure is designed to withstand a gust induced load factor of n equals 3 at cruise altitude, but the low wing loading of the aircraft makes it very sensitive to gusts at lower altitudes, where induced load factors may be in excess of 20. Therefore, a structural load alleviation system is proposed to

limit actual loads to the designed structural limit. Since the transmitting antenna would have a diameter of several hundred feet, it would not be readily transportable; so, it is proposed that a single antenna be constructed at a site from which the aircraft is to be flown. The aircraft would be towed aloft to an initial altitude at which the microwave power would be utilized. The aircraft would climb to cruise altitude in a spiral flight path and then orbit the transmitter in a gentle turn. Author

N91-18171*# Texas A&M Univ., College Station.
ORBITAL DEBRIS REMOVAL AND SALVAGE SYSTEM c18
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 329-331 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Four Texas A&M University projects are discussed. The first project is a design to eliminate a majority of orbital debris. The Orbital Debris and Salvage System will push the smaller particles into lower orbits where their orbits will decay at a higher rate. This will be done by momentum transfer via laser. The salvageable satellites will be delivered to the Space Station by an Orbital Transfer Vehicle. The rest of the debris will be collected by Salvage I. The second project is the design of a space based satellite system to prevent the depletion of atmospheric ozone. The focus is on ozone depletion in the Antarctic. The plan is to use an orbiting solar array system designed to transmit microwaves at a frequency of 22 GHz over the region in order to dissipate polar stratospheric clouds that form during the months beginning in August and ending in October. The third project, Project Poseidon, involves a conceptual design of a space based hurricane control system consisting of a network of 21 low-orbiting laser platforms arranged in three rings designed to heat the upper atmosphere of a developing tropical depression. Fusion power plants are proposed to provide power for the lasers. The fourth project, Project Donatello, involves a proposed Mars exploration initiative for the year 2050. The project is a conceptual design for a futuristic superfreighter that will transport large numbers of people and supplies to Mars for the construction of a full scale scientific and manufacturing complex. Author

N91-18172*# Wisconsin Univ., Madison.
MARS PENETRATOR SAMPLE RETRIEVAL SYSTEM Abstract Only c18
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 333 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

Three University of Wisconsin-Madison space studies are discussed briefly. The Mars Penetrator Retrieval System, used to acquire and analyze soil samples from a region approximately 15 to 30 feet below the Martian surface, uses a drill bit with three cutting tips arranged in a radially terraced formation. A prototype was built and tested. The Mars Egg is a small surface analyzer that would be dropped on the surface of Mars from an orbiter and would analyze the gases present in the surface soil over a period of one Martian year to determine the diffusivity of the soil. The egg contains a gas chromatograph, radio transmitter, and the necessary power supplies. Also discussed is the design of a GeoShack, a manned or unmanned mini-space station in geosynchronous orbit, designed for the repair, attitude correction, and general upkeep of satellites in geosynchnonous orbit. Author

N91-18173*# National Aeronautics and Space Administration, Washington, DC.
BEYOND EARTH'S BOUNDARIES: HUMAN EXPLORATION OF THE SOLAR SYSTEM IN THE 21ST CENTURY Annual Report, 1988
1991 51 p
(NASA-TM-103383; NAS 1.15:103383) Avail: NTIS HC/MF A04 CSCL 22A

This is an annual report describing work accomplished in developing the knowledge base that will permit informed recommendations and decisions concerning national space policy and the goal of human expansion into the solar system. The following topics are presented: (1) pathways to human exploration; (2) human exploration case studies; (3) case study results and assessment; (4) exploration program implementation strategy; (5) approach to international cooperation; (6) recommendations; and (7) future horizons. K.S.

N91-18174 Colorado Univ., Boulder.
THE APPLICATION OF DEPOT TRANSFER/RENDEZVOUS IN SPACE-BASED CYCLIC ORBIT MISSIONS Ph.D. Thesis
Randall Evan Coffey 1990 190 p
Avail: Univ. Microfilms Order No. DA9032816

Future space program mission planning will need means to reduce the cost of mass delivery in support of the future exploration and use of space. To meet the fiscal limits of these programs requires the development of better transportation logistics, both in the primary Earth-to-low Earth orbit (LEO), and secondary orbit-to-orbit space transportation segments for delivery of large mass items and personnel through the use of cyclic, high frequency supply missions from Earth orbiting nodes. The research developed an improved efficiency cyclic orbit transfer method, based on nontraditional optimization criteria, through the use of intermediate propellant depot orbits and rendezvous transfers. The technique was optimized for a reference cyclic transfer between LEO and geostationary earth orbit (GEO) in the presence of realistic mission affects including: (1) nonplanar transfers; (2) perturbed (nonKeplerian) orbit motions; and (3) mission transfer risk mitigation techniques. A semianalytic model was developed to optimize the depot orbit selection and sizing for LEO/GEO cyclic missions for 3 NASA reference OTV mission payload profiles. The results showed some reductions in cyclic mission propellant needs. Dissert. Abstr.

N91-18175*# National Aeronautics and Space Administration, Washington, DC.
FLIGHT OPERATIONS REUNION FOR THE APOLLO 11 20TH ANNIVERSARY OF THE FIRST MANNED LUNAR LANDING
1989 120 p Original contains color illustrations
(NASA-TM-103373; NAS 1.15:103373) Avail: NTIS HC/MF A06; 5 functional color pages CSCL 22A

The following major areas are presented: (1) the Apollo years; (2) official flight control manning list for Apollo 11; (3) original mission control emblem; (4) foundations of flight control; (5) Apollo-11 20th anniversary program and events; (6) Apollo 11 mission operations team certificate; (7) Apollo 11 mission summary (timeline); and (8) Apollo flight control team photographs and biographies. K.S.

N91-18176# Pacific Northwest Lab., Richland, WA.
EXPLORATION MISSION ENHANCEMENTS POSSIBLE WITH POWER BEAMING
Judith Ann Bamberger, Edmund P. Coomes, and Donald R. Segna (Department of Energy, Richland, WA.) Oct. 1990 7 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991
(Contract DE-AC06-76RL-01830)
(DE91-006718; PNL-SA-18509; CONF-910116-15) Avail: NTIS HC/MF A02

A key factor in the exploration and development of the space frontier is the availability of energy where and when it is needed. Currently all space satellites and platforms include self-contained power systems that supply the energy necessary to accomplish mission objectives. An alternative approach is to couple advanced high power system with energy beam transmitters and energy receivers to form an infrastructure of a space power utility where a central power system provides power to multiple users. Major space activities, such as low Earth orbit space commercialization and the colonization of the Moon or Mars, would benefit significantly from a central power generation and transmission system. This paper describes the power-beaming concept and system components as applied to space power generation and distribution in support of the Space Exploration Initiative. Beam-power

scenarios are discussed including commonality of systems and hardware with cargo transport vehicles, power beaming from orbit to stationary and mobile users on the Lunar and Mars surfaces, and other surface applications. DOE

N91-18177# Pacific Northwest Lab., Richland, WA.
AN INTEGRATED MISSION APPROACH TO THE SPACE EXPLORATION INITIATIVE WILL ENSURE SUCCESS
Edmund P. Coomes, Jeffrey E. Dagle, Judith Ann Bamberger, and Kent E. Noffsinger Oct. 1990 8 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991
(Contract DE-AC06-76RL-01830)
(DE91-006721; PNL-SA-18761; CONF-910116-17) Avail: NTIS HC/MF A02

The direction of the American space program, as defined by President Bush and the National Commission on Space, is to expand human presence into the solar system. Landing an American on Mars by the 50th anniversary of the Apollo 11 lunar landing is the goal. This challenge has produced a level of excitement among young Americans not seen for nearly three decades. The exploration and settlement of the space frontier will occupy the creative thoughts and energies of generations of Americans well into the next century. The return of Americans to the moon and beyond must be viewed as a national effort with strong public support if it is to become a reality. Key to making this an actuality is the mission approach selected. Developing a permanent presence in space requires a continual stepping outward from Earth in a logical progressive manner. If we seriously plan to go and to stay, then not only must we plan what we are to do and how we are to do it, we must address the logistic support infrastructure that will allow us to stay there once we arrive. A fully integrated approach to mission planning is needed if the Space Exploration Initiative (SEI) is to be successful. Only in this way can a permanent human presence in space be sustained. An integrated infrastructure approach would reduce the number of new systems and technologies requiring development. The resultant horizontal commonality of systems and hardware would reduce the direct economic impact of SEI while an early return on investment through technology spin-offs would be an economic benefit by greatly enhancing our international technical competitiveness. If the exploration, development, and colonization of space is to be affordable and acceptable, careful consideration must be given to such things as 'return on investment' and 'commercial product potential' of the technologies developed. DOE

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N91-18178 Purdue Univ., West Lafayette, IN.
THE NUMERICAL DETERMINATION OF NOMINAL LIBRATION POINT TRAJECTORIES AND DEVELOPMENT OF A STATION-KEEPING STRATEGY Ph.D. Thesis
Henry John Pernicka 1990 183 p
Avail: Univ. Microfilms Order No. DA9031375

In the circular restricted three body problem, 3-D bounded motion associated with the collinear libration points is known to exist from earlier studies. One such type of trajectory is a Lissajous orbit. Future mission plans include trajectories near the interior libration point in the Sun-Earth system and may consider Lissajous orbits as part of the trajectory design. Except for the special case of the halo orbit, the numerical computation of Lissajous paths has been limited. The determination is considered of such trajectories numerically for an arbitrary, predetermined number of revolutions. A method developed previously for the determination of such orbits in the circular three body problem is extended for use in the elliptic restricted three body problem, as well as with a model that uses polynomial representations of ephemeris data to locate an arbitrary number of attracting bodies. Since Lissajous trajectories are unstable, spacecraft moving on these paths must use some form of trajectory control to remain close to their normal orbit. A stationkeeping strategy was developed applicable to libration point trajectories that uses maneuvers executed at discrete time intervals. Propellant costs related to maneuvers are examined. Dissert. Abstr.

N91-18179# Technische Univ., Berlin (Germany, F.R.). Fachbereich Verkehrswesen.
ERROR ELLIPSOIDS WITH PARTICULAR REFERENCE TO POSITION ERRORS OF INTERPLANETARY TRAJECTORIES Ph.D. Thesis [FEHLERELLIPSOIDE MIT BESONDEREM BEZUG ZU ORTUNGSFEHLERN AUF INTERPLANETAREN BAHNEN]
Brigitte Brunner 1990 109 p In GERMAN
(ETN-91-98791) Avail: NTIS HC/MF A06

A computation and three dimensional representation of error ellipsoids is presented. Computation examples show the applicability of algorithms developed for position determinations of interplanetary trajectories. The non-orthogonal sensitive axis system and the scatterings adapted to these sensitive axes are computed. They depend on measurement processes used. The error ellipsoid is calculated following the orthogonalization of the sensitive axis system. The mean calculated position is its center. A graphical program is developed for the optimal three dimensional representation of the error ellipsoid, as determined by its form and situation. It offers a number of representation possibilities. ESA

N91-19012*# Louisiana Coll., Pineville. Dept. of Mathematics and Computer Science.
A HIGH-FIDELITY SATELLITE EPHEMERIS PROGRAM FOR EARTH SATELLITES IN ECCENTRIC ORBITS
David R. Simmons *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22A

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N91-19016*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
DESIGN AND IMPLEMENTATION OF A GROUND CONTROL CONSOLE PROTOTYPE FOR OMV
Bruce L. Walcott *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N91-18180*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PARAMETRIC TRADE STUDIES ON A SHUTTLE 2 LAUNCH SYSTEM ARCHITECTURE
Douglas O. Stanley, Theodore A. Talay, Roger A. Lepsch, W.

Douglas Morris, J. Christopher Naftel, and Christopher I. Cruz
Washington Mar. 1991 56 p
(NASA-TP-3059; L-16790; NAS 1.60:3059) Avail: NTIS HC/MF A04 CSCL 22D

A series of trade studies are presented on a complementary architecture of launch vehicles as a part of a study often referred to as Shuttle-2. The results of the trade studies performed on the vehicles of a reference Shuttle-2 mixed fleet architecture have provided an increased understanding of the relative importance of each of the major vehicle parameters. As a result of trades on the reference booster-orbiter configuration with a methane booster, the study showed that 60 percent of the total liftoff thrust should be on the booster and 40 percent on the orbiter. It was also found that the liftoff thrust to weight ratio (T/W) on the booster-orbiter should be 1.3. This leads to a low dry weight and still provides enough thrust to allow the design of a heavy lift architecture. As a result of another trade study, the dry weight of the reference booster-orbiter was chosen for a variety of operational considerations. Other trade studies on the booster-orbiter demonstrate that the cross feeding of propellant during boost phase is desirable and that engine-out capability from launch to orbit is worth the performance penalty. Technology assumptions made during the Shuttle-2 design were shown to be approx. equivalent to a 25 percent across the board weight reduction over the Space Shuttle technology. The vehicles of the Shuttle-2 architecture were also sized for a wide variety of payloads and missions to different orbits. Many of these same parametric trades were also performed on completely liquid hydrogen fueled fully reusable concepts. If a booster-orbiter is designed using liquid hydrogen engines on both the booster and orbiter, the total vehicle dry weight is only 3.0 percent higher than the reference dual-fuel booster-orbiter, and the gross weight is 3.8 percent less. For this booster-orbiter vehicle, a liftoff T/W of 1.3, a thrust of about 60 percent on the booster, and a Mach staging number of 3 all proved to be desirable. This modest dry weight increase for a liquid hydrogen fueled Shuttle-2 system should be more than offset by the elimination of the entire hydrocarbon engine development program and the savings in operation cost realized by the elimination of an entire fuel type.
Author

N91-18976*# Alabama Univ., Huntsville. Dept. of Computer Science.
NATIONAL LAUNCH STRATEGY VEHICLE DATA MANAGEMENT SYSTEM
David Cordes *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N91-18181*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ATTACHED SHUTTLE PAYLOAD CARRIERS: VERSATILE AND AFFORDABLE ACCESS TO SPACE
1990 20 p Original contains color illustrations
(NASA-TM-103395; NAS 1.15:103395) Avail: NTIS HC/MF A03; 12 functional color pages CSCL 22B

The shuttle has been primarily designed to be a versatile vehicle for placing a variety of scientific and technological equipment in space including very large payloads; however, since many large payloads do not fill the shuttle bay, the space and weight margins remaining after the major payloads are accommodated often can be made available to small payloads. The Goddard Space Flight Center (GSFC) has designed standardized mounting structures and other support systems, collectively called attached shuttle payload (ASP) carriers, to make this additional space available to researchers at a relatively modest cost. Other carrier systems for ASP's are operated by other NASA centers. A major feature of the ASP carriers is their ease of use in the world of the Space Shuttle. ASP carriers attempt to minimized the payload interaction with Space Transportation System (STS) operations whenever possible. Where this is not possible, the STS services used are not extensive. As a result, the interfaces between the carriers and the STS are simplified. With this near autonomy, the requirements for supporting documentation are considerably lessened and payload costs correspondingly reduced. The ASP carrier systems and their capabilities are discussed in detail. The range of available capabilities assures that an experimenter can select the simplest, most cost-effective carrier that is compatible with his or her experimental objectives. Examples of payloads which use ASP basic hardware in nonstandard ways are also described.
Author

N91-18182# Sandia National Labs., Albuquerque, NM. Transportation Div.
JUSTIFICATION FOR USING SCALE MODELS FOR IMPACT RESPONSE EVALUATION OF THE SST TRANSPORTATION SYSTEM
R. E. Berry Dec. 1990 10 p
(Contract DE-AC04-76DP-00789)
(DE91-006100; SAND-90-2337) Avail: NTIS HC/MF A02

The validity of scale model impact evaluation of Supersonic Transportation System is acceptable based on Dimensional Analysis (Buckingham Pi Theorem) and the work of numerous programs that have evaluated the agreement among dimensional analysis, several different reduced-size models and full-scale impact test data. Excellent accuracy has been demonstrated between scale models and full-scale impact data when collected in conformance with the Buckingham Pi Theorem.
DOE

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N91-18320*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
THE ADVANCED RECEIVER 2: TELEMETRY TEST RESULTS IN CTA 21
S. Hinedi, R. Bevan, and M. Marina *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 140-156 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 14F

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N91-18183 Princeton Univ., NJ.
THE CONTROLLED RETRIEVAL OF A TETHERED SATELLITE Ph.D. Thesis
Alexander Hermann Boschitsch 1990 177 p
Avail: Univ. Microfilms Order No. DA9027540

There is much interest in the dynamics and control of tethers for space applications. The control of a tethered subsatellite during the inherently unstable retrieval process poses one of the greater challenges in this area. The dynamics and control of tethered subsatellite retrieval are studied in order to find ways of attenuating the rigid body motions. An idealized model incorporating a variable length, massive, flexible, and entensible tether, is first defined and the extended Hamilton's Principle used to obtain the governing partial differential equations of motion. The reduced rigid body equations are then derived and used in addressing two fundamental questions regarding the deterministic subsatellite retrieval problem: (1) Can acceptable rigid body motions be produced using retrieval rate as the only control, which is addressed by formulating and numerically solving a nonlinear trajectory optimization problem using a conjugate gradient algorithm. (2) Can one produce acceptable rigid body motions during retrieval using a controller designed via linear quadratic feedback theory, addressed by extending by the out-of-plane motion and also retaining the time varying nature of the linearized tether equation. A key determinant for both controllers and their behaviors is the cost function on which they are based.
Dissert. Abstr.

N91-18184*# Texas A&M Univ., College Station. Decision and Information Systems Lab.
ACTIVE VIBRATION CONTROL TECHNIQUES FOR FLEXIBLE SPACE STRUCTURES Final Report, 1 Apr. 1989 - 30 Sep. 1990
Alexander G. Parlos and Suhada Jayasuriya Oct. 1990 110 p
(Grant NAG9-347)
(NASA-CR-185643; NAS 1.26:185643; REPT-90-DISL-06) Avail: NTIS HC/MF A06 CSCL 22B

Two proposed control system design techniques for active vibration control in flexible space structures are detailed. Control issues relevant only to flexible-body dynamics are addressed, whereas no attempt was made to integrate the flexible and rigid-body spacecraft dynamics. Both of the proposed approaches revealed encouraging results; however, further investigation of the interaction of the flexible and rigid-body dynamics is warranted.
Author

N91-18185*# Texas A&M Univ., College Station. Decision and Information Systems Lab.
ATTITUDE CONTROL/MOMENTUM MANAGEMENT AND PAYLOAD POINTING IN ADVANCED SPACE VEHICLES Contractor Report, Jun. 1988 - May 1990
Alexander G. Parlos and Suhada Jayasuriya Aug. 1990 194 p
(Grant NAG9-275)
(NASA-CR-185644; NAS 1.26:185644; REPT-90-DISL-05) Avail: NTIS HC/MF A09 CSCL 22B

The design and evaluation of an attitude control/momentum management system for highly asymmetric spacecraft configurations are presented. The preliminary development and application of a nonlinear control system design methodology for tracking control of uncertain systems, such as spacecraft payload pointing systems are also presented. Control issues relevant to both linear and nonlinear rigid-body spacecraft dynamics are addressed, whereas any structural flexibilities are not taken into consideration. Results from the first task indicate that certain commonly used simplifications in the equations of motions result in unstable attitude control systems, when used for highly asymmetric spacecraft configurations. An approach is suggested circumventing this problem. Additionally, even though preliminary results from the second task are encouraging, the proposed nonlinear control system design method requires further investigation prior to its application and use as an effective payload pointing system design technique.
Author

N91-18186*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE 5TH ANNUAL NASA SPACECRAFT CONTROL LABORATORY EXPERIMENT (SCOLE) WORKSHOP, PART 1
Lawrence W. Taylor, Jr., comp. Dec. 1990 383 p Workshop held in Lake Arrowhead, CA, 31 Oct. 1988
(NASA-CP-10057-PT-1; NAS 1.55:10057-PT-1) Avail: NTIS HC/MF A17 CSCL 22B

The modeling, systems identification, and control synthesis for the Spacecraft Control Laboratory Experiment (SCOLE) configuration are examined.
Author

N91-18187*# National Aeronautics and Space Administration, Washington, DC.
CASSINI. REPORT ON THE PHASE A STUDY: SATURN ORBITER AND TITAN PROBE
Oct. 1988 46 p Prepared in cooperation with ESA, Paris, France
(NASA-TM-103374; NAS 1.15:103374; SCI(88)5) Avail: NTIS HC/MF A03 CSCL 22B

An in-depth, second phase exploration of Saturn is proposed. The scientific objectives involving Titan, Saturn's rings, icy satellites, magnetosphere, Jupiter, asteroids, and cruise science are covered. Other topics presented include: (1) the model payloads; (2) project requirements; (3) mission; (4) launch vehicle; (5) the orbiter system; (6) the Titan probe system; (7) mission operations; (8) management; and (9) development plan.
K.S.

N91-18188*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
INTEGRATION OF MECHANISM AND CONTROL FOR LARGE-ANGLE SLEW MANEUVERS OF FLEXIBLE STRUCTURES Final Report, period ended 31 Aug. 1990
Meng-Sang Chew Feb. 1991 38 p
(Grant NAG1-952)
(NASA-CR-187876; NAS 1.26:187876) Avail: NTIS HC/MF A03 CSCL 22B

A rolling contact noncircular gear system is applied to assist a desired controller in the slewing of a flexible space structure. The varying gear ratio in cooperation with the controller results in lower feedback gains at the controller, as well as considerably reducing flexural vibrations of the space structure. The noncircular gears consist of a pair of convex noncircular cylinders with specially designed profiles that are synthesized in conjunction with the optimal controller gains for minimizing the flexural vibrations of flexible structure during a slew maneuver. Convexity of the cylindrical profiles for this noncircular gear device must be ensured to maintain rolling contact between the two cylinders. Simulations of slewing control tasks for two kinds of flexible space structures, such as a planar flexible beam and the planar articulated flexible beams, are presented.
Author

N91-18189*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SECOND CONFERENCE ON NDE FOR AEROSPACE REQUIREMENTS
Kenneth W. Woodis, comp., Craig C. Bryson, comp., and Gary L. Workman, comp. (Alabama Univ., Huntsville.) Washington Dec. 1990 276 p Conference held in Huntsville, AL, 22-24 Aug. 1989; sponsored by NASA. Marshall Space Flight Center and Alabama Univ.
(NASA-CP-3091; M-646; NAS 1.55:3091) Avail: NTIS HC/MF A13 CSCL 22B

Nondestructive evaluation and inspection procedures must constantly improve rapidly in order to keep pace with corresponding advances being made in aerospace material and systems. In response to this need, the 1989 Conference was organized to provide a forum for discussion between the materials scientists, systems designers, and NDE engineers who produce current and future aerospace systems. It is anticipated that problems in current systems can be resolved more quickly and that new materials and structures can be designed and manufactured in such a way as to be more easily inspected and to perform reliably over the life cycle of the system. For individual titles, see N91-18190 through N91-18198.

N91-18190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEVELOPMENT AND APPLICATIONS OF NONDESTRUCTIVE EVALUATION AT MARSHALL SPACE FLIGHT CENTER c38
Ann F. Whitaker *In its* Second Conference on NDE for Aerospace Requirements Dec. 1990 p 15-24 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 14D

A brief description of facility design and equipment, facility usage, and typical investigations are presented for the following: Surface Inspection Facility; Advanced Computer Tomography Inspection Station (ACTIS); NDE Data Evaluation Facility; Thermographic Test Development Facility; Radiographic Test Facility; Realtime Radiographic Test Facility; Eddy Current Research Facility; Acoustic Emission Monitoring System; Advanced Ultrasonic Test Station (AUTS); Ultrasonic Test Facility; and Computer Controlled Scanning (CONSCAN) System. B.G.

N91-18191*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
SPACE SHUTTLE MAIN ENGINE COMPUTED TOMOGRAPHY APPLICATIONS c20
Richard F. Sporny *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 25-32 (For primary document see N91-18189 10-18)
(Contract NAS8-40000)
Avail: NTIS HC/MF A13 CSCL 21H

For the past two years the potential applications of computed tomography to the fabrication and overhaul of the Space Shuttle Main Engine were evaluated. Application tests were performed at various government and manufacturer facilities with equipment produced by four different manufacturers. The hardware scanned varied in size and complexity from a small temperature sensor and turbine blades to an assembled heat exchanger and main injector oxidizer inlet manifold. The evaluation of capabilities included the ability to identify and locate internal flaws, measure the depth of surface cracks, measure wall thickness, compare manifold design contours to actual part contours, perform automatic dimensional inspections, generate 3D computer models of actual parts, and image the relationship of the details in a complex assembly. The capabilities evaluated, with the exception of measuring the depth of surface flaws, demonstrated the existing and potential ability to perform many beneficial Space Shuttle Main Engine applications. Author

N91-18192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
REVIEW OF ACOUSTO-ULTRASONIC NDE FOR COMPOSITES c24
Alex Vary and Harold Kautz *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 33-49 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 11D

Acousto-ultrasonics utilizes simulated stress waves to detect and quantify defect states, damage conditions, and variations of mechanical properties in fiber reinforced composites. The term acousto-ultrasonics denotes a combination of aspects of acoustic emission methodology with ultrasonic materials characterization. The acousto-ultrasonic approach was developed to deal primarily with evaluation of the integrated effect of minor flaws and diffuse flaw populations of subcritical flaws in composite and bonded structures. These factors singly and collectively also influence acousto-ultrasonic measurements that, in turn, correlate with dynamic response and mechanical property variations. Since it was first introduced, the acousto-ultrasonic approach was successfully applied to a variety of materials, including polymeric, metallic, and ceramic matrix composites; adhesively bonded materials; paper and wood products; cable and rope; and also human bone. Examples of applications and limitations of the approach are reviewed. Basic methods and guidelines are discussed. The underlying hypothesis and theory development needs are indicated. Author

N91-18193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACOUSTO-ULTRASONIC NONDESTRUCTIVE EVALUATION OF MATERIALS USING LASER BEAM GENERATION AND DETECTION c38
Robert D. Huber, Robert E. Green, Jr. (Johns Hopkins Univ., Baltimore, MD.), Alex Vary, and Harold Kautz *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 51-82 (For primary document see N91-18189 10-18)
(Grant NAG3-728)
Avail: NTIS HC/MF A13 CSCL 14D

Presented in viewgraph format, the possibility of using laser generation and detection of ultrasound to replace piezoelectric transducers for the acousto-ultrasonic technique is advanced. The advantages and disadvantages of laser acousto-ultrasonics are outlined. Laser acousto-ultrasonics complements standard piezoelectric acousto-ultrasonics and offers non-contact nondestructive evaluation. B.G.

N91-18194*# South Carolina Univ., Columbia.
IMAGE CORRELATION NONDESTRUCTIVE EVALUATION OF IMPACT DAMAGE IN A GLASS FIBER COMPOSITE c24
Samuel S. Russell *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 83-106 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 11D

Presented in viewgraph format, digital image correlation, damage in fibrous composites, and damaged coupons (cross-ply scotchply GI-Ep laminate) are outlined. It was concluded that the image correlation accuracy was 0.03 percent; strains can be processed through Tsai-Hill failure criteria to qualify the damage; the statistical data base must be generated to evaluate certainty of the damage estimate; size effects need consideration; and better numerical techniques are needed. B.G.

N91-18195*# Oak Ridge National Lab., TN.
EDDY-CURRENT INSPECTION OF SHUTTLE HEAT EXCHANGER TUBE WELDS c38
Casius V. Dodd, G. W. Scott (Martin Marietta Corp., New Orleans, LA.), and L. D. Chitwood *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 107-12 Previously announced as N90-15462 (For primary document see N91-18189 10-18)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A13 CSCL 14D

The goal of this project was to develop the system necessary to demonstrate in the laboratory that an eddy current system can inspect the tubes and welds described, screening for the existence of flaws equal in size to, or larger than, the target flaw. The laboratory system was to include the probe necessary to traverse the tubing, the electronics to drive (i.e., electrically excite) the probe and receive and process signals from it, a data display, data recording, and playback devices, and microprocessor software or firmware necessary to operate the system. DOE

N91-18196*# Idaho National Engineering Lab., Idaho Falls.
ACOUSTO-OPTIC SIGNATURE ANALYSIS FOR INSPECTION OF THE ORBITER THERMAL PROTECTION TILE BONDS
Julio G. Rodriguez, D. M. Tow, and B. A. Barna *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 149-16 Previously announced as N90-16043 Sponsored by NASA, Kennedy Space Center (For primary document see N91-18189 10-18)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC/MF A13 CSCL 22B

The goal of this research is to develop a viable NDE technique for the inspection of orbiter thermal protection system (TPS) tile bonds. Phase 2, discussed here, concentrated on developing an empirical understanding of the bonded and unbonded vibration signatures of acreage tiles. Controlled experiments in the laboratory have provided useful information on the dynamic response of TPS tiles. It has been shown that several signatures are common to

all the pedigree tiles. This degree of consistency in the tile-SIP (strain isolation pad) dynamic response proves that an unbond can be detected for a known tile and establish the basis for extending the analysis capability to arbitrary tiles for which there are no historical data. The field tests of the noncontacting laser acoustic sensor system, conducted at the Kennedy Space Center (KSC), investigated the vibrational environment of the Orbiter Processing Facility (OPF) and its effect on the measurement and analysis techniques being developed. The data collected showed that for orbiter locations, such as the body flap and elevon, the data analysis scheme, and/or the sensor, will require modification to accommodate the ambient motion. Several methods were identified for accomplishing this, and a solution is seen as readily achievable. It was established that the tile response was similar to that observed in the laboratory. Of most importance, however, is that the field environment will not affect the physics of the dynamic response that is related to bond condition. All of this information is fundamental to any future design and development of a prototype system. Author

N91-18197*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ULTRASONIC CORRELATOR VERSUS SIGNAL AVERAGER AS A SIGNAL TO NOISE ENHANCEMENT INSTRUMENT **c38**
Doron Kishoni and Benjamin E. Pietsch (Industrial Quality, Inc., Gaithersburg, MD.) *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 187-19 Previously announced in IAA as A91-19665 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 14D

Ultrasonic inspection of thick and attenuating materials is hampered by the reduce amplitudes of the propagated waves to a degree that the noise is too high to enable meaningful interpretation of the data. In order to overcome the low signal to noise ratio (S/N), a correlation technique has been developed. In this method, a continuous pseudo-random pattern generated digitally is transmitted and detected by piezoelectric transducers. A correlation is performed in the instrument between the received signal and a variable delayed image of the transmitted one. The result is shown to be proportional to the impulse response of the investigated material, analogous to a signal received from a pulsed system, with an improved S/N ratio. The degree of S/N enhancement depends on the sweep rate. The correlator is described, and it is compared to the method of enhancing S/N ratio by averaging the signals. The similarities and differences between the two are highlighted and the potential advantage of the correlator system is explained. Author

N91-18198*# Martin Marietta Corp., Huntsville, AL.
AN AUTOMATIC GORE PANEL MAPPING SYSTEM **c38**
John D. Shiver and Norman N. Phelps *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 264-26 (For primary document see N91-18189 10-18)
(Contract NAS8-30300)
Avail: NTIS HC/MF A13 CSCL 14D

The Automatic Gore Mapping System is being developed to reduce the time and labor costs associated with manufacturing the External Tank. The present chem-milling processes and procedures are discussed. The down loading of the simulation of the system has to be performed to verify that the simulation package will translate the simulation code into robot code. Also a simulation of this system has to be programmed for a gantry robot instead of the articulating robot that is presently in the system. It was discovered using the simulation package that the articulation robot cannot reach all the point on some of the panels, therefore when the system is ready for production, a gantry robot will be used. Also a hydrosensor system is being developed to replace the point-to-point contact probe. The hydrosensor will allow the robot to perform a non-contact continuous scan of the panel. It will also provide a faster scan of the panel because it will eliminate the in-and-out movement required for the present end effector. The system software is currently being modified so that the hydrosensor will work with the system. The hydrosensor consists of a Krautkramer-Branson transducer encased in a plexiglass nozzle. The water stream pumped through the nozzle is the couplant for the probe. Also, software is being written so that the robot will have the ability to draw the contour lines on the panel displaying the out-of-tolerance regions. Presently the contour lines can only be displayed on the computer screens. Research is also being performed on improving and automating the method of scribing the panels. Presently the panels are manually scribed with a sharp knife. The use of a low power laser or water jet is being studied as a method of scribing the panels. The contour drawing pen will be replaced with scribing tool and the robot will then move along the contour lines. With these developments the Automatic Gore Mapping Systems will provide a reduction in time and labor costs associated with manufacturing the External Task. The system also has the potential of inspecting other manufactured parts. Author

N91-18199* National Aeronautics and Space Administration, Washington, DC.
LARGE SPACE STRUCTURES AND SYSTEMS IN THE SPACE STATION ERA: A BIBLIOGRAPHY WITH INDEXES
John J. Ferrainolo, ed. (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Nov. 1990 350 p
(NASA-SP-7085(01); NAS 1.21:7085(01)) Avail: NTIS HC A16 CSCL 22B

Bibliographies and abstracts are listed for 1372 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1, 1990 and June 30, 1990. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. Author

N91-18200# Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Raumfahrttechnik.
THE SPACE STATION AS A STATION FOR INTERPLANETARY MISSIONS Ph.D. Thesis [DIE RAUMSIMULATION ALS BAHNHOF FUER INTERPLANETARE MISSIONEN]
Michael H. Obersteiner 1989 109 p In GERMAN
(ETN-91-98799) Avail: NTIS HC/MF A06

The take off orbit and its consequences on orbit mechanics and mission planning are examined. Based on an idealized preliminary investigation, orbit computation is realized and evaluated for Earth Mars orbits. The developed algorithm includes complex conical sections, impulse Hohmann transfer stations, Lambert problem and parameter optimization. Growth factors are to be included for the Space Station, in the next interplanetary missions. ESA

N91-18201# European Space Agency, Paris (France).
MANNED SPACE STATIONS: THEIR CONSTRUCTION, OPERATION AND POTENTIAL APPLICATIONS
Rodolfo Neri (Secretaria de Comunicaciones y Transportes, Copacabana Beach, Mexico) and B. Battrick, ed. Nov. 1990 119 p Sponsored in part by EEC Original contains color illustrations
(ESA-SP-1137; ISBN-92-9092-124-2; ISSN-0379-6566; ETN-91-98802) Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The following are discussed: the importance of manned space stations and the possibilities offered by performing experiments in microgravity; the characteristics and effects of the space environment; the basic architecture of manned space stations as well as the missions performed by the Salyuts, Skylab, MIR, the Space Shuttle and the Spacelab; the Space Station Freedom; and the financing of manned space stations and the pros and cons of multilateral cooperation. For individual titles, see N91-18202 through N91-18206.

N91-18202# European Space Agency, Paris (France).
THE IMPORTANCE OF MANNED SPACE STATIONS
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 3-7 Original contains color illustrations (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The possibilities offered in performing experiments and microgravity tests on space stations are presented. The pros and cons of these space stations being 'manned' are discussed. An explanation of gravity and its effects is given. Space stations offer unique opportunities for long duration experiments and the manufacturing of rare materials. They offer scientists and engineers the opportunity to broaden their understanding of the Universe and the origin of life and their knowledge can be applied to important technical applications. People with financial objectives, pharmaceutical, chemical, computing, and telecommunication industries, can exploit the unique conditions for making new and rare products such as more effective high purity medicines, alloys, semiconductors and ceramics. Satellite communications and remote sensing are two space industries which are already successful. Despite the great differences in complexity in manned and unmanned space stations the former are more advantageous since man has capabilities machines can not match. They also enable a better understanding of the effects of weightlessness and isolation on human physiology and psychology. The movements of the crew in the space station are disadvantageous as they produce small disturbances in the simulated microgravity levels in the Earth orbit. The disadvantages of the hostile space environment, confinement, and safety are discussed. ESA

N91-18203# European Space Agency, Paris (France).
THE SPACE ENVIRONMENT: CHARACTERISTICS AND EFFECTS
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 11-26 Original contains color illustrations (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The space environment in low Earth orbit is an unfriendly place for both spacecraft and life forms. To exploit it properly, it is necessary to understand both its characteristics and corresponding effects on living organisms. Some of these characteristics offer advantages or involve only minor problems that can be resolved, while others are very hazardous and unpredictable. In space, there are not only the phenomena of microgravity, vacuum, and extreme temperature, but also lethal radiations and high speed junk that can severely damage or even destroy a space station. Each of these phenomena and the effects they have on the space station and the crew are discussed. Means of overcoming the possible disadvantageous effects are discussed and ways of exploiting space conditions are presented. ESA

N91-18204# European Space Agency, Paris (France).
BASIC ARCHITECTURE OF MANNED SPACE STATIONS
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 29-95 Original contains color illustrations (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

Manned space stations are very complex structures. Adequate conditions and facilities for conducting experiments, material processing and scientific observations must be provided as well as safety and comfort for the crew. As a complex orbiting structure, a manned space station is divided into a set of major engineering systems to facilitate its design, construction and operation. All of these systems are closely interrelated in their working; therefore, they need to be defined, manufactured, and integrated together in a mutually coherent manner in order to guarantee safe and efficient operation. These systems include: structures; electrical power; thermal control; guidance navigation and control propulsion; automation and robotics; communications and tracking/data management; environmental control and life support/fluid management; crews systems and accommodations; and crew and payload transportation. Details of past, present, and planned manned space stations including the 7 Soviet Salyuts, the American Skylab, the Soviet MIR and the U.S. Space Shuttle and Spacelab are given. The experience gained, the launching of the station and crew, the electrical systems, the experimentation and research, and any problems encountered are discussed. ESA

N91-18205# European Space Agency, Paris (France).
SPACE STATION FREEDOM
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 99-114 Original contains color illustrations (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The idea of constructing a modern manned space station in low Earth orbit had been considered by NASA for about two decades before its development was finally approved, at which time emphasis was put on the need to invite international participation. Political, economic, and human factors have shaped the course of events in relation to Space Station Freedom. The objectives and international participation including the United States, European, Canadian, and Japanese contributions are discussed as well as the construction, assembly sequence and future evolution. ESA

N91-18206# European Space Agency, Paris (France).
SOME COMMENTS ON MULTILATERAL COOPERATION **c84**
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 117-119 (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The financing of manned space stations and the pros and cons of multilateral cooperation are discussed. Launching and operating these manned space stations is essentially a totally government funded venture, since no private company is prepared to invest in them until adequate revenues can be expected in the short term. However the government funded nature and very high costs involved means delays and budgetary cuts can seriously hinder and delay proceedings. When international cooperation is involved, for example the Space Station Freedom, one country's cut can seriously affect another country's budget. Naturally there are advantages to international cooperation from the scientific point of view since combining intellectual, technological, and economic resources allows advances to be made faster and more efficiently. It is stated that the need for every partner to receive 'reciprocal benefits' is the best formula for cooperation. ESA

N91-18207# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
USERS MANUAL FOR AEROSPACE NUCLEAR SAFETY PROGRAM SIX-DEGREE-OF-FREEDOM REENTRY SIMULATION (TMAGRA6C)
R. C. Sharbaugh Feb. 1990 189 p
(Contract DE-AI01-88NE-32140)
(DE91-005925; DOE/NE-32140/20; JHU/APL-ANSP-M-20)
Avail: NTIS HC/MF A09

This report documents the updated six-degree-of-freedom reentry simulation TMAGRA6C used in the Aerospace Nuclear Safety Program, ANSP. The simulation provides for the inclusion of the effects of ablation on the aerodynamic stability and drag of reentry bodies, specifically the General Purpose Heat Source, GPHS. The existing six-degree-of-freedom reentry body simulations (TMAGRA6A and TMAGRA6B) used in the Johns Hopkins University Applied Physics Laboratory Nuclear Safety Program do not include aerodynamic effects resulting from geometric changes to the configuration due to ablation from reentry flights. A wind tunnel test was conducted in 1989 to obtain the effects of ablation on the hypersonic aerodynamics of the GPHS module. The analyzed data were used to form data sets which are included herein in tabular form. These are used as incremental aerodynamic

inputs in the new TMAGRA6C six-degree-of-freedom reentry simulation. DOE

N91-18123*# Arizona Univ., Tucson.
AUTONOMOUS SPACE PROCESSOR FOR ORBITAL DEBRIS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 11-21 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18126*# University of Central Florida, Orlando.
POSTLANDING OPTIMUM DESIGNS FOR THE ASSURED CREW RETURN VEHICLE
Kenneth C. Hosterman and Loren A. Anderson *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 35-39 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18133*# Houston Univ., TX. Coll. of Architecture.
SPACEPORT AURORA: AN ORBITING TRANSPORTATION NODE
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 69-78 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18136*# Illinois Univ., Urbana-Champaign.
AN UNMANNED PROBE TO PLUTO
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 93-97 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18142*# Michigan Univ., Ann Arbor.
PROJECT EGRESS: THE DESIGN OF AN ASSURED CREW RETURN VEHICLE FOR THE SPACE STATION
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 129-135 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18143*# Minnesota Univ., Minneapolis.
BICONIC CARGO RETURN VEHICLE WITH AN ADVANCED RECOVERY SYSTEM
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 137-144 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18144*# Minnesota Univ., Minneapolis.
WINGED CARGO RETURN VEHICLE CONCEPTUAL DESIGN
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 145-151 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18146*# Ohio State Univ., Columbus.
PROJECT WISH: THE EMERALD CITY
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 165-168 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18148*# Pennsylvania State Univ., University Park.
PRELIMINARY SUBSYSTEM DESIGNS FOR THE ASSURED CREW RETURN VEHICLE (ACRV)
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 175-181 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18154*# Naval Academy, Annapolis, MD.
MIMES AND GEOSHACK
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 213-216 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

N91-18155*# Utah State Univ., Logan.
MICROSPACECRAFT AND EARTH OBSERVATION: ELECTRICAL FIELD (ELF) MEASUREMENT PROJECT
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 217-219 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18156*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THREE ORBITAL TRANSFER VEHICLES
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 221-227 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18161*# California State Univ., Northridge.
AUTONOMOUS MARTIAN FLYING ROVER Abstract Only
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 273 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18171*# Texas A&M Univ., College Station.
ORBITAL DEBRIS REMOVAL AND SALVAGE SYSTEM
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 329-331 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-18172*# Wisconsin Univ., Madison.
MARS PENETRATOR SAMPLE RETRIEVAL SYSTEM Abstract Only
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 333 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22B

N91-19005*# Alabama Univ., Tuscaloosa. Dept. of Industrial Engineering.
EMERGENCY EGRESS REQUIREMENTS FOR SPACE STATION FREEDOM
Paul S. Ray *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

N91-19007*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.
CHARACTERIZATION OF SPACE STATION MULTILAYER INSULATION DAMAGE DUE TO HYPERVELOCITY SPACE DEBRIS IMPACT
William Keith Rule *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

N91-19019*# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
IMPLEMENTATION STRATEGIES FOR LOAD CENTER AUTOMATION ON THE SPACE STATION MODULE/POWER MANAGEMENT AND DISTRIBUTION TESTBED
Karen Watson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

N91-19021*# Auburn Univ., AL. Dept. of Mechanical Engineering.
VERIFICATION OF COMPONENT MODE TECHNIQUES FOR FLEXIBLE MULTIBODY SYSTEMS
Gloria J. Wiens *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N91-18208*# Thiokol Corp., Brigham City, UT. Space Operations.
SPACE SHUTTLE PRODUCTION VERIFICATION MOTOR 1 (PV-1) FIELD JOINT PROTECTION SYSTEM, VOLUME 7 Final Report
J. P. Wilkinson 10 Dec. 1990 11 p
(Contract NAS8-30490)
(NASA-CR-184105; NAS 1.26:184105; TWR-17592-VOL-7)
Avail: NTIS HC/MF A03 CSCL 21H

The performance of the field joint protection system (FJPS) of the Space Shuttle Production Verification Motor 1 (PV-1), as evaluated by postfire hardware inspection. Compliance with the specifications is shown for the FJPS assembly and components. The simplified FJPS and field joint heaters performed nominally, maintaining all joint seal temperatures within the required range. One anomally was noted on the igniter-to-case joint heater during postfire inspection. The heater buckled off the surface in two areas, resulting in two hot spots on the heater and darkened heater insulation. The condition did not affect heater performance during ignition countdown and all igniter seals were maintained within required temperature limits. Author

N91-18209*# Mississippi State Univ., Mississippi State. Dept. of Electrical and Computer Engineering.
SPACE LAB SYSTEM ANALYSIS: ADVANCED SOLID ROCKET MOTOR (ASRM) COMMUNICATIONS NETWORKS ANALYSIS Final Report, Nov. 1989 - Nov. 1990
Frank M. Ingels, Robert J. Moorhead, II, Jane N. Moorhead, C. Mark Shearin, and Dale R. Thompson 31 Dec. 1990 39 p
(Contract NAS8-36717)
(NASA-CR-184103; NAS 1.26:184103; MSU-EE-FIN-30-90)
Avail: NTIS HC/MF A03 CSCL 21H

A synopsis of research on computer viruses and computer security is presented. A review of seven technical meetings attended is compiled. A technical discussion on the communication plans for the ASRM facility is presented, with a brief tutorial on the potential local area network media and protocols. Author

N91-18210# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
A PRELIMINARY STAGE CONFIGURATION FOR A LOW PRESSURE NUCLEAR THERMAL ROCKET (LPNTR)
C. F. Leyse, W. W. Madsen, J. E. Neuman, J. H. Ramsthaler, and B. G. Schnitzler 1990 8 p Presented at the American Institute of Aeronautics and Astronautics (AIAA) Space Programs and Technologies Conference, Huntsville, AL, 25-27 Sep. 1990 Previously announced in IAA as A91-10151
(Contract DE-AC07-76ID-01570)
(DE91-006110; EGG-M-90432; CONF-9009324-1) Avail: NTIS HC/MF A02

A low pressure nuclear thermal rocket (LPNTR) is configured to meet the requirements of a nuclear stage for manned Mars exploration. Safety, reliability, and performance are given equal consideration in selecting the stage configuration. Preliminary trade studies are conducted to size the engine thrust and determine the thrust chamber pressure. A weight breakdown and mechanical configuration for the selected LPNTR concept are defined. A seven engine stage configuration is selected which gives a two engine out capability and eliminates the need for engine gimbaling. The stage can be ground assembled and launched as a unit including tankage for trans-Earth injection and Earth orbital capture. The tankage is configured to eliminate the need for an inert shield. The small engine will be cheaper to develop than a single engine providing full thrust, and will be compatible with stages for Earth orbital, Lunar, and deep space missions. Mission analyses are presented with engine operation in a high thrust mode and in a dual range high thrust-low thrust mode. Mass savings over a reference NERVA stage are projected to be 45 to 55 percent for the high thrust operating mode and 50 to 60 percent for the dual range mode. Potential exists for further increases in performance by optimizing the thrust chamber/nozzle design. DOE

N91-18211# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
A CASE FOR MARS: A CASE FOR NUCLEAR THERMAL ROCKETS
J. E. Neuman, D. H. VanHaaften, and W. W. Madsen 1990 10 p Presented at the Case for Mars 4 Conference, Boulder, CO, 6 Jun. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006143; EGG-M-90143; CONF-9006307-1) Avail: NTIS HC/MF A02

It is now possible to make general comparisons of candidate propulsion systems for human exploration of Mars. Preliminary review indicates that the propulsion system most likely to meet all mission requirements is the Nuclear Thermal Rocket (NTR). Advanced cryogenic chemical propulsion systems achieve a maximum specific impulse (Isp) of about 470 seconds. The Nuclear Engine for Rocket Vehicle Application (NERVA) program of the 1960's built engines with Isp's of about 825 seconds. Performance of an NTR depends on achievable materials temperatures, but materials has progressed significantly since the 1960's. Also, some of the current research undertaken to improve chemical rocket performance, such as aerobraking or schemes to minify payload, applies to an NTR as well, although it is not essential. The NTR is reusable, and can be developed into a complete space transportation system. Only 3 to 4 percent of the nuclear fuel would be used in a Mars mission, and an engine can be used until about 40 percent of the fuel is expended. Nuclear thermal rockets can take mankind to the moon, to Mars, and beyond, but development must begin now. There is potential for orderly growth into nuclear concepts far beyond NERVA. Using chemical propulsion for lunar missions and delaying NTR development will only result in higher costs and delayed or cancelled Mars missions. DOE

N91-18124*# California Univ., Los Angeles.
LABORATORY SIMULATION OF THE ROCKET MOTOR THRUST AS A FOLLOWER FORCE
In USRA, Proceedings of the 6th Annual Summer Conference:

NASA/USRA University Advanced Design Program Nov. 1990 p 23-26 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 21H

N91-18191*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
SPACE SHUTTLE MAIN ENGINE COMPUTED TOMOGRAPHY APPLICATIONS
Richard F. Sporny *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 25-32 (For primary document see N91-18189 10-18)
(Contract NAS8-40000)
Avail: NTIS HC/MF A13 CSCL 21H

N91-18969*# Mississippi State Univ., Mississippi State. Dept. of Physics and Astronomy.
BIAS AND UNCERTAINTY IN THE ABSORPTION EMISSION MEASUREMENT OF ATOMIC SODIUM DENSITY IN THE SSME EXIT PLANE
Leslie E. Bauman *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

N91-18985*# Tennessee Technological Univ., Cookeville. Dept. of Mechanical Engineering.
IGNITION TRANSIENT ANALYSIS OF SOLID ROCKET MOTOR
Samuel S. Han *In* Alabama Univ., Research Reports, 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N91-18212 Georgia Inst. of Tech., Atlanta.
EFFECT OF DIFFERENT BINDERS AND ADDITIVES ON SANDWICH BURNING Ph.D. Thesis
Christos P. Markou 1988 227 p
Avail: Univ. Microfilms Order No. DA8916163

An experimental investigation into the effects of the energetic binders BAMO-THF and NMMO on sandwich burning was conducted. Two-dimensional sandwich models of a composite propellant consisting of a layer of binder 'sandwiched' between two slabs of ammonium perchlorate were employed. Comparable tests using BAMO-THF and NMMO (energetic binders) and PBAN (standard inert binder) were carried out and the effects of three catalysts (Fe2O3, Fe3O4, and catocene) added to the binder were studied. The amount of modifier added was sustained in percentages encountered in real propellant mixtures. Both combustion photography and microscopy were helpful in sketching the surface profiles of the samples at different pressures for several binder thicknesses. The burning rates for uncatalyzed and catalyzed binder sandwiches were plotted as a function of binder lamina thickness and of test pressure. The effectiveness of each catalyst was measured at each test condition. The qualitative theory of flame complex described earlier for the PBAN binder was applied and extended for the case of new energetic binders and postulates were developed for the action of the iron based catalysts introduced in the binder lamina. This expanded flame theory was able to qualitatively predict burning rate trends, surface profiles, and flame structures based on ingredient properties related to combustion, thermochemistry of the oxidizer/binder system, pressure changes and binder lamina thickness variations. Dissert. Abstr.

N91-18213 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DAMAGE STATES IN LAMINATED COMPOSITE THREE-POINT BEND SPECIMENS: AN EXPERIMENTAL/ANALYTICAL CORRELATION STUDY Ph.D. Thesis
James Michael Starbuck 1990 356 p
Avail: Univ. Microfilms Order No. DA9023181

Damage states in laminated composites were studied by considering the model problem of a laminated beam subjected to three point bending. A combination of experimental and theoretical research techniques was used to correlate the experimental results with the analytical stress distributions. The analytical procedure was based on the stress formulation approach of the mathematical theory of elasticity. The solution procedure is capable of calculating the ply-level stresses and beam displacements for any laminated beam of finite length using the generalized plane deformation or plane stress state assumption. The experimental study was conducted to determine the different damage modes in laminated three point bend specimens. The test matrix consisted of three point bend specimens of 0 deg unidirectional, cross ply, and quasiisotropic stacking sequences. The dependence of the damage initiation loads and ultimate failure loads were studied, and their relation to damage susceptibility and damage tolerance of the beam configuration was discussed. The four damage mechanisms identified were delaminations, matrix cracking, fiber breakage, and crushing. Dissert. Abstr.

N91-18214 Pennsylvania State Univ., University Park.
EFFECT OF INTERFACES ON CONTINUOUS FIBER-REINFORCED BRITTLE MATRIX COMPOSITES Ph.D. Thesis
Richard Anthony Shimansky 1989 162 p
Avail: Univ. Microfilms Order No. DA9018279

The development of toughened brittle matrix composites (BMC) requires weak or nonexistent chemical bonding at the fiber matrix interface to improve longitudinal toughness. However, over-weakened bonding reduces the longitudinal strength of BMC. Predictive models were developed to quantify the effect of modified interfaces on both transverse and longitudinal behavior of a unidirectional BMC lamina. Under transverse tensile loads, the experimentally measured strength and stiffness of a unidirectional BMC lamina have shown a dramatic decrease from that predicted by existing models. A 2-D finite element model of a transverse representative volume element was developed to illustrate that weakened or debonded interfaces are responsible for the decrease in transverse mechanical properties. Interface debonding was represented by active gap elements connecting the fiber and matrix. Using this model, the effects of fiber-matrix displacement compatibility at the interface on both transverse elastic properties and transverse strength were studied for tensile and compressive transverse loadings. The model results accurately predict the transverse strength and stiffness of a composite, and indicate that BMC transverse elastic properties are not linear elastic. The longitudinal behavior of BMC was also modeled. Dissert. Abstr.

N91-18215*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPRESSION BEHAVIOR OF GRAPHITE-THERMOPLASTIC AND GRAPHITE-EPOXY PANELS WITH CIRCULAR HOLES OR IMPACT DAMAGE
Dawn C. Jegley Washington Mar. 1991 18 p
(NASA-TP-3071; L-16853; NAS 1.60:3071) Avail: NTIS HC/MF A03 CSCL 11D

An experimental investigation of the compression behavior of laminated specimens made from graphite-epoxy tape,

graphite-thermoplastic tape and graphite-thermoplastic fabric was conducted. Specimens with five different stacking sequences were loaded to failure in uniaxial compression. Some of the specimens had central circular holes with diameters up to 65 percent of the specimen width. Other specimens were subjected to low speed impact with impact energies up to 35 J prior to compressive loading. This investigation indicates that graphite-thermoplastic specimens with holes have up to 15 percent lower failure stresses and strains than graphite-epoxy specimens with the same stacking sequence and hole size. However, graphite-thermoplastic specimens subjected to low speed impact have up to 15 percent higher failure stresses and strains than graphite-epoxy specimens with the same stacking sequence and impact energy. Compression tests of graphite-thermoplastic specimens constructed of unidirectional tape and fabric indicate that the material form has little effect on failure strains in specimens with holes or low speed impact damage. Author

N91-18216*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVESTIGATION OF MICROSTRUCTURAL CHANGES IN POLYETHERETHER-KETONE FILMS AT CRYOGENIC TEMPERATURES BY POSITRON LIFETIME SPECTROSCOPY
Jag J. Singh, Abe Eftekhari (Analytical Services and Materials, Inc., Hampton, VA.), Terry L. St.Clair, and Danny R. Sprinkle Washington Mar. 1991 13 p
(NASA-TP-3064; L-16841; NAS 1.60:3064) Avail: NTIS HC/MF A03 CSCL 11D

Microstructural changes in Polyetherether-ketone (PEEK) films were investigated in the temperature ranges of 23 to -196 C, using Positron Lifetime Spectroscopy (PLS) technique. It was determined that the total free volume decreases by about 46 percent in amorphous PEEK samples and about 36 percent in semicrystalline PEEK samples when they are cooled down from room temperature to liquid nitrogen (LN2) temperature. If this trend in reduction in free volume with decreasing temperature continues, as expected, it is surmised that PEEK will be able to withstand cooling down to liquid hydrogen (LH2) temperature without any detrimental effect on its diffusivity for liquid hydrogen. Author

N91-18217 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DAMORHEOLOGY: CREEP-FATIGUE INTERACTION IN COMPOSITE MATERIALS Ph.D. Thesis
Ricardo Osiroff 1990 288 p
Avail: Univ. Microfilms Order No. DA9032496

The interaction mechanisms of time dependent material behavior and cyclic damage during fatigue loading of fiber reinforced composite laminates are addressed. A new term, damorheology, was coined to describe such physical behavior. The lamina was chosen as the building block and a cross ply laminate configuration was the selected test case. The chosen material system is the Radel X/T65-42 thermoplastic composite by Amoco. The fatigue performance at the lamina level is represented by the dynamic stiffness, residual strength, and fatigue life of unidirectional laminates. The time dependent behavior is represented at the lamina level by a pseudo-analog mechanical model. The thermo-rheological characterization procedure combines mechanical (creep) and thermal (dynamic mechanical analysis) techniques. The proposed rheological model provides a complete representation of the effects of temperature and stress on the viscoelastic response. The experimental investigation of unidirectional and cross ply laminates revealed that indeed there are significant changes in the time dependent response of a laminate due to fatigue loading. In turn, the viscoelastic stress redistribution is responsible for the changes in the rate of damage evolution and varying extent of damage modes. Time dependent constitutive relationships were derived for the laminate in the form of differential equations. Applying classical lamination stress analysis together with the shear lag model, the damage evolution of cross ply laminates was predicted. Based on the laminae viscoelastic and fatigue characteristics, a cyclic performance simulation code, CYPERS, was developed. The code was designed to predict the long term performance of cross ply laminates subjected to cyclic loads. The analysis and/or accompanying code have produced satisfactory predictions for a variety of situations. The model and code provide a complete representation of the laminate long term performance. It includes: dynamic stiffness, global deformation, complex moduli and compliance, temperature history, frequency response of the complex moduli, damage state, time dependent stress redistribution, residual strength, and fatigue life. Dissert. Abstr.

N91-18218# Conservatoire National des Arts et Metiers, Paris (France). Dept. of Industrial Materials Engineering.
EVALUATION AND MODELING OF DELAMINATION UNDER STATIC AND CYCLIC LOADING
C. Bathias and R. Khoshravan 1991 15 p
Avail: NTIS HC/MF A03

A part of the VAMAS program on polymer composite delamination in mode 1 and in mode 2 is presented. Glass and carbon fiber reinforced polymers were studied. Monotonic and cyclic loadings are applied at DCB specimens. The results show that the criteria of fracture mechanics are able to describe the material behavior. A tentative effort is made to standardize a method to determine the R curve and da/dN curve for composite delamination. Author

N91-18219# Tokyo Medical and Dental Univ. (Japan). Inst. for Medical and Dental Engineering.
STUDIES ON THE TESTING METHOD OF CARBON FIBER REINFORCED PLASTICS: COMPRESSION, SHEAR AND IMPACT TESTS
Hiroo Miyairi, Masahiro Nagai, and Kazuo Takakuda 1991 15 p
Avail: NTIS HC/MF A03

In order to develop applications of new materials that will advance industrial equipment, high performance aircraft, high grade sports gear, etc., standards of testing methods for these materials must be established. Hence in this decade, the Japanese have performed research studies of the standardization of testing methods for such new materials as metal, organic, rubber, and inorganic materials. Since carbon reinforced plastics are so popular and promising, the Ministry on International Trade and Industry (MITI) started the standardization project in 1985 and supported the Japan High Polymer Center for their activity. The status of this project on fiber reinforced materials is presented, and the items of recent work are discussed. Author

N91-18220# Argonne National Lab., IL. Materials and Components Technology Div.
THREE-DIMENSIONAL NUCLEAR MAGNETIC RESONANCE AND X RAY MICROTOMOGRAPHIC IMAGING OF COMPOSITE MATERIALS
S. L. Dieckman, N. Gopalsami, R. E. Botto, and P. Rizo (Commissariat a l'Energie Atomique, Grenoble, France) 1990 11 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990
(Contract W-31-109-eng-38)
(DE91-006477; CONF-901105-74) Avail: NTIS HC/MF A03

A new 3-D nuclear magnetic resonance (NMR) imaging technique is presented for nondestructive evaluation of green-state ceramic composite materials. The technique is based on a 3-D backprojection protocol for data acquisition combined with a Radon reconstruction technique. Particularly for NMR of solid materials, this imaging protocol can provide higher 3-D spatial resolution than is possible with commonly applied slice-selection protocols. The applicability of this 3-D NMR imaging technique was demonstrated using whisker reinforced Si3N4/Si3N4 ceramic composites. While NMR is a sensitive and unique method for spatial discrimination of chemical properties (e.g., organic distributions), x ray CT is a sensitive and proven technique for determining variations in density (i.e., voids and inclusions) within an object. The complementary nature of these two techniques was shown by imaging a piece of green ceramic composite material by both NMR and x ray microtomography techniques. DOE

N91-18221# Royal Aerospace Establishment, Farnborough (England).
PRECIPITATION REACTIONS IN 8090 SIC PARTICULATE REINFORCED MMC
E. Hunt, P. D. Pitcher, and P. J. Gregson (Southampton Univ., England) 25 Apr. 1990 14 p
(RAE-TR-90040; RAE-MAT/STR-291; BR115301; ETN-91-98629)
Copyright Avail: NTIS HC/MF A03

Microhardness testing, differential scanning calorimetry and transmission electron microscopy are used to study the precipitation reactions in the matrix of 8090 SiC metal matrix composite (MMC). Unreinforced 8090 produced via the powder route and also by ingor metallurgy was similarly studied for comparison. The 8090 MMC matrix exhibited a more rapid age hardening response than the unreinforced alloy, but this accelerated aging cannot be attributed to enhanced precipitation. It is suggested that rapid formation of GPB zones or increased dislocation interaction may be responsible for this effect. ESA

N91-18222*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A DAMAGE TOLERANCE COMPARISON OF IM7/8551 AND IM8G/8553 CARBON/EPOXY COMPOSITES
D. G. Lance and A. T. Nettles Feb. 1991 20 p
(NASA-TM-103526; NAS 1.15:103526) Avail: NTIS HC/MF A03 CSCL 11D

A damage tolerance study of two new toughened carbon fiber/epoxy resin systems was undertaken as a continuation of ongoing work into screening new opposites for resistance to foreign object impact. This report is intended to be a supplement to NASA TP 3029 in which four new fiber/resin systems were tested for damage tolerance. Instrumented drop weight impact testing was used to inflict damage to 16-ply quasi-isotropic specimens. Instrumented output data and cross-sectional examinations of the damage zone were utilized to quantify the damage. It was found that the two fiber/resin systems tested in this study were much more impact resistant than an untoughened composite such as T300/934, but were not as impact resistant as other materials previously studied. Author

N91-18223*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FRACTURE MECHANICS ANALYSIS FOR VARIOUS FIBER/MATRIX INTERFACE LOADINGS
R. A. Naik (Analytical Services and Materials, Inc., Hampton, VA.) and J. H. Crews, Jr. Feb. 1991 21 p
(NASA-TM-104049; NAS 1.15:104049) Avail: NTIS HC/MF A03 CSCL 11D

Fiber/matrix (F/M) cracking was analyzed to provide better understanding and guidance in developing F/M interface fracture toughness tests. Two configurations, corresponding to F/M cracking at a broken fiber and at the free edge, were investigated. The effects of mechanical loading, thermal cooldown, and friction were investigated. Each configuration was analyzed for two loadings: longitudinal and normal to the fiber. A nonlinear finite element analysis was performed to model friction and slip at the F/M interface. A new procedure for fitting a square-root singularity to calculated stresses was developed to determine stress intensity factors (K sub I and K sub II) for a bimaterial interface crack. For the case of F/M cracking at a broken fiber with longitudinal loading, crack tip conditions were strongly influenced by interface friction. As a result, an F/M interface toughness test based on this case was not recommended because nonlinear data analysis methods would be required. For the free edge crack configuration, both mechanical and thermal loading caused crack opening, thereby avoiding frictional effects. A F/M interface toughness test based on this configuration would provide data for K(sub I)/K(sub II) ratios of about 0.7 and 1.6 for fiber and radial normal loading, respectively. However, thermal effects must be accounted for in the data analysis. Author

N91-18224# Lawrence Livermore National Lab., CA.
MULTIAXIAL FAILURE CHARACTERIZATION OF COMPOSITES
S. E. Groves Oct. 1990 21 p Presented at the 6th Meeting of Interagency Mechanical Operations Group, Amarillo, 1-3 May 1990
(Contract W-7405-eng-48)
(DE91-005397; UCRL-JC-105244; CONF-9005165-2-VUGRAPHS)
Avail: NTIS HC/MF A03

The objective of this study was the characterization of three-dimensional failure response of continuous fiber composite materials utilized at LLNL. This report discusses the scope of the work, tests, results and the summary of work on the failure characterization of composites. DOE

N91-18225# California Univ., Berkeley. Lawrence Berkeley Lab.
AN HISTORICAL MULLITE FIBER-REINFORCED CERAMIC COMPOSITE: CHARACTERIZATION OF THE 'WOOTZ' CRUCIBLE REFRACTORY
T. L. Lowe (California Univ., Berkeley.), N. Merk, and G. Thomas Oct. 1990 17 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, 16-21 Apr. 1990
(Contract DE-AC03-76SF-00098)
(DE91-005401; LBL-29769; CONF-900466-94) Avail: NTIS HC/MF A03

Since at least the sixteenth century, the 'wootz' ultra-high carbon white cast-iron ingot was produced in India by melting or carburizing iron in a crucible. This ingot was forced into sword blades of so-called Damascus steel. The charged crucible was fired in a long (24-hour) single cycle at high temperature (1150 to 1250 C) in a strongly reducing atmosphere. Raw materials for the refractory vessel are clay and 'coked' rice husks. At high temperatures, two phases reinforce the glassy matrix: cristobalite relics of rice husks and a network of mullite crystals. This paper characterizes the microstructure and chemistry of the mullite network in the glassy matrix by means of a combination of techniques: optical microscopy, XRD, SEM, TEM and EDS, and HREM. DOE

N91-18226# Pacific Northwest Lab., Richland, WA.
SIMPLE STRESSED-SKIN COMPOSITES USING PAPER REINFORCEMENT
L. R. Bunnell Nov. 1990 7 p Presented at the National Educators' Workshop: Update 1990, Gaithersburg, 13-15 Nov. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005610; PNL-SA-18601; CONF-9011163-1) Avail: NTIS HC/MF A02

The composite reinforcement concept was demonstrated in a hands-on manner, using readily available materials in order to: (1) demonstrate the consequences of certain defects in these structures; and (2) quantify the gains made by engineering composite construction, using a simple measurement of Young's modulus of elasticity. The materials used were foam rubber beams, beams reinforced on one side by bonding with heavy paper, a beam reinforced on both sides by bonding with heavy paper, and a beam with a defect caused by using a piece of waxed paper midway to prevent bonding of the paper. The experiment is designed to teach students at the high school level or above the concept of Young's modulus, a measure of a material's stiffness. DOE

N91-18014# Wichita State Univ., KS. Dept. of Aerospace Engineering.
ENVIRONMENTAL EFFECTS ON DELAMINATION OF GRAPHITE EPOXY COMPOSITES
Steve Hooper *In its* Proceedings: Techfest 17 1991 p 9-13
(For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
REVIEW OF ACOUSTO-ULTRASONIC NDE FOR COMPOSITES

Alex Vary and Harold Kautz *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 33-49 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 11D

N91-18194*# South Carolina Univ., Columbia.
IMAGE CORRELATION NONDESTRUCTIVE EVALUATION OF IMPACT DAMAGE IN A GLASS FIBER COMPOSITE
Samuel S. Russell *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 83-106 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N91-18227 Texas Univ., Arlington.
A NUMERICAL SIMULATION OF SHOCK-ENHANCED MIXING IN SUPERSONIC COMBUSTION Ph.D. Thesis
Neal David Domel 1990 180 p
Avail: Univ. Microfilms Order No. DA9033477

The development of supersonic combustion engines requires the ability to control fuel/air mixing with supersonic shear layers. The qualitative effect of an oblique shock impinging on a reacting shear layer of this type is examined. The Total Variation Diminishing (TVD) scheme is used in a Beam Warming approximate factorization numerical algorithm to solve the 2-D Navier-Stokes (N-S) equations and the species transport equations. The N-S solver is explicitly coupled to the chemistry package and allows for variable specific heats, molecular weights, and heat of formation. Also used is the algebraic turbulence model of Baldwin and Lomax. The TVD N-S solver is tested and validated with a series of nonreacting cases. The fully reacting turbulent flow is then numerically simulated. A comparison is made among five reacting cases. The numerical results of this model are compared to the experimental data of Burrows and Kurkov who ran wind tunnel tests on a combustion case with no shock impingement. The results of this analysis show that the impingement of an oblique shock does enhance the turbulent mixing and combustion. Dissert. Abstr.

N91-18228 Texas Univ., Austin.
EXPERIMENTAL AND NUMERICAL STUDIES OF SOLID FUEL COMBUSTION IN AN OPPOSED FLOW CONFIGURATION Ph.D. Thesis
Barbara Ellen Johnson 1990 154 p
Avail: Univ. Microfilms Order No. DA9031603

An experimental and numerical study of solid fuel combustion in an opposed flow configuration is presented. The system studied was an opposed flow diffusion flame (OFDF), modified so that a solid fuel replaced the gaseous fuel jet. A numerical study was undertaken because previous numerical models of OFDF systems do not effectively account for the interaction between the fluid dynamics and chemical kinetics. Boundary values and physical dimensions for the numerical model were provided from experimental study. Ignition in the OFDF experimental system was achieved through the use of a CO2 laser as a radiative energy source. The numerical model included transient Navier-Stokes equations for an axisymmetric system and a full chemical kinetic mechanism for formaldehyde. From the experimental and numerical study, it can be concluded that a definition of flame stretch based on the far field flow is not appropriate for reacting systems. The local stretch can be very different due to the effect of the energy released in the reaction zone on the fluid dynamics.
Dissert. Abstr.

N91-18229# Purdue Univ., West Lafayette, IN. School of Chemical Engineering.
GAS-LIQUID-LIQUID EQUILIBRIA IN MIXTURES OF WATER, LIGHT GASES, AND HYDROCARBONS Final Report, 1 Sep. 1987 - 30 Nov. 1990
K. C. Chao 1990 26 p
(Contract DE-FG02-84ER-13288)
(DE91-004168; DOE/ER-13288/T1) Avail: NTIS HC/MF A03

Phase equilibrium in mixtures of water + light gases and water + heavy hydrocarbons has been investigated with the development of new local composition theory, new equations of state, and new experimental data. The preferential segregation and orientation of molecules due to different energies of molecular interaction has been simulated with square well molecules. Extensive simulation has been made for pure square well fluids and mixtures to find the local composition at wide ranges of states. A theory of local composition has been developed and an equation of state has been obtained for square well fluids. The new local composition theory has been embedded in several equations of state. The pressure of water is decoupled into a polar pressure and non-polar pressure according to the molecular model of water of Jorgensen et al. The polar pressure of water is combined with the BACK equation for the general description of polar fluids and their mixtures. Being derived from the steam table, the Augmented BACK equation is particularly suited for mixtures of water + non-polar substances such as the hydrocarbons. The hydrophobic character of the hydrocarbons had made their mixtures with water a special challenge. A new group contribution equation of state is developed to describe phase equilibrium and volumetric behavior of fluids while requiring only to know the molecular structure of the components. DOE

N91-18230# Northwestern Univ., Evanston, IL. Dept. of Engineering Sciences and Applied Mathematics.
STUDIES IN NONLINEAR PROBLEMS OF ENERGY Progress Report
Bernard J. Matkowsky Nov. 1990 48 p
(Contract DE-FG02-87ER-25027)
(DE91-005081; DOE/ER-25027/T1) Avail: NTIS HC/MF A03

A research program was performed with primary emphasis on the applications of Bifurcation and Stability Theory to Problems of energy, with specific emphasis on Problems of Combustion and Flame Propagation. In particular the problem of transition from laminar to turbulent flame propagation was considered. A great deal of progress was made in the investigations. More than one hundred and thirty papers citing this project have been prepared for publication in technical journals. A list of the papers, including abstracts for each paper, is appended to this report. DOE

N91-18231# Sandia National Labs., Albuquerque, NM.
INTERACTIONS AT GLASS-CERAMIC TO METAL INTERFACES
G. A. Knorovsky, R. K. Brow, R. D. Watkins, and R. E. Loehman 1990 8 p Presented at the 2nd International Ceramic Science and Technology Congress, Orlando, FL, 12-15 Nov. 1990
(Contract DE-AC04-76DP-00789)
(DE91-006630; SAND-90-1511C; CONF-901125-9) Avail: NTIS HC/MF A02

Advanced pyrotechnic components can be fabricated from Ni-based superalloys with hermetic seals to high expansion lithium-silicate glass ceramics (LSGC). Prior studies have characterized the interfacial reactions in these systems necessary for good chemical bonding. Similar reactions occur when LSGCs are bonded to 300-series stainless steel except that these seals debond on cooling to room temperature. Cr-depletion from approx. 18 wt percent to approx. 5 wt percent from the steel interface cases an fcc-to-bcc phase transition that expands the interfacial grains and decreases their thermal expansion coefficient, putting the LSGC into tension, causing the seal to fail. DOE

N91-18232# Rensselaer Polytechnic Inst., Troy, NY. High-Temperature Reaction Kinetics Lab.
KINETIC MEASUREMENTS ON ELEMENTARY FOSSIL FUEL COMBUSTION REACTIONS OVER WIDE TEMPERATURE RANGES Progress Report, 1 Dec. 1989 - 30 Nov. 1990
Arthur Fontijn Jan. 1991 8 p
(Contract DE-FG02-84ER-13224)
(DE91-006815; DOE/ER-13224/13) Avail: NTIS HC/MF A02

The goals of this work are to provide accurate data on the temperature dependence of the kinetics of elementary combustion reactions (1) for use by combustion modelers, and (2) to gain a better fundamental understanding of, and hence predictive ability for, the chemistry involved. In this reporting period our work on the O + HCl reaction was published, experimental work on the O + benzene and O + 1-butene reactions was completed, and measurements on the O + isobutene reaction were initiated. DOE

N91-18233# Georgia Inst. of Tech., Atlanta. School of Chemistry and Biochemistry.
FUNDAMENTAL STUDIES WITH A MONODISPERSE AEROSOL-BASED LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY INTERFACE (MAGIC-LC/MS) Progress Report, 1 Dec. 1989 - 30 Nov. 1990
Richard F. Browner Oct. 1990 7 p
(Contract DE-FG05-85ER-13435)
(DE91-004875; DOE/ER-13435/5) Avail: NTIS HC/MF A02

Accomplishments on the fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry (LC/MS) interface during the period 1 December 1989 to 30 November 1990 are summarized. In order to determine the influence of temperature on the vaporization and decomposition properties of molecules, tests have been carried out on both thermally stable and thermally labile molecules. The test compounds used were a series of polynuclear aromatic (PAH) compounds covering a wide range of molecular weights from two-ring naphthalene to twelve-ring perylene. The less thermally stable species examined were aldicarb, a highly thermally labile pesticide, and cholesterol, which readily loses water when subjected to high temperatures. A new, externally heated probe, which can be raised to temperatures as high as 500 C was also used. Matrix loading effects for a range of surface active and non-surface active compounds in three different matrices: glycerol, 3-nitrobenzyl alcohol, and thioglycerol for fast atom bombardment (FAB) particle beam LC/MS have been studied. The time dependence of FAB spectra generation in the particle beam system has been examined and contrasted with ion generation in normal probe FAB work. Future FAB LC/MS research is outlined. DOE

N91-18234# Tennessee Univ., Knoxville. Dept. of Chemistry.
CAPILLARY LIQUID CHROMATOGRAPHY USING LASER-BASED AND MASS SPECTROMETRIC DETECTION Technical Progress Report, 1 Sep. 1989 - 31 Jan. 1991
Michael J. Sepaniak and K. D. Cook 1990 13 p
(Contract DE-FG05-86ER-13613)
(DE91-004887; DOE/ER-13613/19) Avail: NTIS HC/MF A03

The DOE-supported research performed during the past year has mainly focused on investigating and minimizing three problems that limit the practical utility of these capillary electrokinetic separation techniques in chemical analysis. Analyses are hindered by poor reproducibility. This is largely a result of complicated and irreproducible capillary wall-solute interactions that often result in adsorption and mobility changes. While the micellar electrokinetic capillary chromatography (MECC) technique permits the separations of neutral solutes, hydrophobic compounds are difficult to separate and manipulation of capacity factors (k's) is critically important. The very small solute band volumes require that on-column detection be performed (usually optical detection) and this seriously limits detectability. In addition to these projects, the electrokinetic equivalent of affinity chromatography and development of remote fiber-optic sensors to measure chemical carcinogens and other compounds have been investigated. DOE

N91-18235# Louisville Univ., KY.
METALLOCARBOXYLATE CHEMISTRY Progress Report, 1989 - 1990
Dorothy H. Gibson 1990 6 p
(Contract DE-FG05-86ER-13538)
(DE91-006313; DOE/ER-13538/5) Avail: NTIS HC/MF A02

Work in the past year has concentrated on completing manuscripts describing the synthesis, isolation and characterization of seven metallocarboxylate anions, M-COOM' (M = CpFe(CO)(PPh3) or Cp asterisk Fe(CO)(PPh3); M' = alkali metal) and compounds derived from these anions. Four of the anions are hydrated, the others are anhydrous analogs of three of them. The electron-rich metal centers bind CO2 strongly in all cases; thermolysis occurs through initial hydrolysis to the corresponding metallocarboxylic acid and subsequent decomposition of the latter compound. DOE

N91-18236# Sandia National Labs., Albuquerque, NM. Process Optimization and Control Div.
IDENTIFICATION OF SURFACE CONTAMINANTS USING INFRARED MICRO-PROFILING
D. S. Blair and K. J. Ward 1990 10 p Presented at the 3rd Symposium on Particles on Surfaces: Detection, Adhesion, and Removal in conjunction with the 21st Annual Meeting of the Fine Particle Society, San Diego, CA, 21-25 Aug. 1990
(Contract DE-AC04-76DP-00789)
(DE91-006779; SAND-90-1191C; CONF-900882-1) Avail: NTIS HC/MF A02

Infrared micro-profiling is the combination of infrared microspectroscopy with precise microscope stage movements. It can provide molecular and spatial information for a variety of samples as small as 10 (mu)m in diameter. To illustrate the technique different contaminant materials, including a cellulose acetate fiber, oils deposited in a fingerprint, and a thin film of solder flux residue, were infrared micro-profiled. An integrated absorbance data reduction technique commonly used in gas chromatography/FT-IR applications was applied to the micro-profiling data. This technique organizes the vast amount of data generated, enabling the user to plot the results in three-dimensional projections, allowing extraction of relevant spatial information. A method of coadding spectra from different pixel elements, providing higher quality spectra without increasing data acquisition time, is presented. This procedure improves spectral signal-to-noise which aids in the identification of unknown contaminants. DOE

N91-18237*# Eloret Corp., Palo Alto, CA.
ALL-ELECTRON MOLECULAR DIRAC-HARTREE-FOCK CALCULATIONS: THE GROUP 4 TETRAHYDRIDES CH4, SiH4, GeH4, SnH4 AND PbH4
Kenneth G. Dyall, Peter R. Taylor, Knut Faegri, Jr., and Harry Partridge (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) [1990] 43 p Sponsored in part by the Norwegian Research Council for Science and the Humanities
(Contracts NCC2-552; NCC2-371)
(NASA-CR-187968; NAS 1.26:187968) Avail: NTIS HC/MF A03 CSCL 21B

A basis-set-expansion Dirac-Hartree-Fock program for molecules is described. Bond lengths and harmonic frequencies are presented for the ground states of the group 4 tetrahydrides, CH4, SiH4, GeH4, SnH4, and PbH4. The results are compared with relativistic effective core potential (RECP) calculations, first-order perturbation theory (PT) calculations and with experimental data. The bond lengths are well predicted by first-order perturbation theory for all molecules, but non of the RECP's considered provides a consistent prediction. Perturbation theory overestimates the relativistic correction to the harmonic frequencies; the RECP calculations underestimate the correction. Author

N91-18238# Akron Univ., OH. Dept. of Chemical Engineering.
THE EFFECT OF CHEMICAL ADDITIVES ON THE SYNTHESIS OF ETHANOL
S. S. C. Chuang Nov. 1990 33 p
(Contract DE-FG22-87PC-79923)
(DE91-006633; DOE/PC-79923/T4) Avail: NTIS HC/MF A03

The objective of this research is to elucidate the role of additives on the ethanol synthesis over Rh- and Ni-based catalysts. Chemical additives used for this study will include S, P, Ag, Cu, Mn, and Na which have different electronegativities. The effect of additives on the surface state of the catalysts, heat of adsorption of reactant molecules, reaction intermediates, reaction pathways, reaction kinetics, and product distributions is/will be investigated by a series of experimental studies of NO adsorption, reaction probing, study state rate measurement, and transient kinetic study. A better understanding of the role of additive on the synthesis reaction may allow them to use chemical additives to manipulate the catalytic properties of Rh- and Ni-based catalysts for producing high yields of ethanol from syngas. DOE

N91-18239# Pacific Northwest Lab., Richland, WA.
FINAL REPORT ON THE CHARACTERIZATION OF THE FILM ON INERT ANODES
C. F. Windisch, Jr. and N. D. Stice Jan. 1991 45 p
(Contract DE-AC06-76RL-01830)
(DE91-007425; PNL-7589) Avail: NTIS HC/MF A03

Results of post-test microscopic and elemental analysis of the reaction zone on polarized cermet inert anodes, over a range of current densities and alumina concentrations, suggest that an alumina film does not form to protect the anode from dissolution. Rather, significant morphological and compositional changes occur at or near the anode surface. These changes and the chemical reactions that cause them involve the cermet material itself and appear to be responsible for properties that were previously assigned to an alumina film. In particular, a reaction layer formed from the cermet material may have protective properties, while changes in roughness and porosity may contribute to the electrochemical impedance. DOE

N91-18240# Ames Lab., IA.
INDIRECT FLUOROMETRIC DETECTION TECHNIQUES ON THIN LAYER CHROMATOGRAPHY AND EFFECT OF ULTRASOUND ON GEL ELECTROPHORESIS Ph.D. Thesis
Ma Yinfa 10 Dec. 1990 154 p
(Contract W-7405-eng-82)
(DE91-007519; IS-T-1502) Avail: NTIS HC/MF A08

Thin-layer chromatography (TLC) is a broadly applicable separation technique. It offers many advantages over high performance liquid chromatography (HPLC), such as easily adapted for two-dimensional separation, for whole-column detection and for handling multiple samples, etc. However, due to its draggy development of detection techniques in comparison with HPLC, TLC has not received the attention it deserves. Therefore, exploring new detection techniques is very important to the development of TLC. It is the principal of this dissertation to present an indirect fluorometric detection method for TLC. This detection technique is universally sensitive, nondestructive, and simple. This will be described in detail from Sections 1 through Section 5. Section 1 and 3 describe the indirect fluorometric detection of anions and nonelectrolytes in TLC. In Section 2, a detection method for cations based on fluorescence quenching of ethidium bromide is presented. In Section 4, a simple and interesting TLC experiment is designed, three different fluorescence detection principles are used for the determination of caffeine, saccharin, and sodium benzoate in beverages. A laser-based indirect fluorometric detection technique in TLC is developed in Section 5. Section 6 is totally different from Sections 1 through 5. An ultrasonic effect on the separation of DNA fragments in agarose gel electrophoresis is investigated. DOE

N91-18241# Colorado Univ., Boulder.
STUDIES OF MELTING, CRYSTALLIZATION, AND COMMENSURATE-INCOMMENSURATE TRANSITIONS IN TWO DIMENSIONS
R. C. Mockler and W. J. OSullivan Jun. 1990 15 p
(Contract DE-FG02-86ER-45236)
(DE91-007567; DOE/ER-45236/T3) Avail: NTIS HC/MF A03

The four year period of this contract was devoted to the study of two dimensional systems of particles in their fluid and crystalline phases and especially in their behavior on passage through the freezing/melting (F/M) transition. Monolayers of microspheres both on the surface of water and trapped in water films between parallel quartz plates were used in these studies. In addition, macroscopic-size steel spheres were used in similar studies jointly with Noel Clark's group. There was only partial agreement with the predictions of theory in the F/M behavior of these 3 systems. The air/water (A/W) interface experiments displayed a two-step continuous F/M transition in agreement with theory for 2.99 micron particles with a definite intermediate phase. An A/W system of 1.01 micron spheres exhibits what we interpreted to be a first order transition with a very narrow coexistence region in place of the hexatic phase. The trapped water film monolayer experiments using 1.01 micron spheres showed the same behavior, i.e., a narrow range of two-phase coexistence and a first order F/M transition. The steel spheres displayed a definite first order F/M transition. The techniques of electron-beam lithography and plasma etching were used to produce square arrays of wells and parallel linear channels on a quartz plate. This together with a second parallel smooth plate confined a monolayer of 1.01 micron spheres in a water film. Damped lattice dynamics and hydrodynamics interactions were studied using the techniques of autocorrelation spectroscopy on a crystalline monolayer on the surface of water. Thermal relaxation times and Lame coefficients were obtained. Experiments were initiated to measure the variation of the surface tension of an A/W interface containing a crystalline monolayer at different states of compression. DOE

N91-18986*# Alabama A & M Univ., Normal. Dept. of Chemistry.
STRUCTURE FUNCTION CALCULATIONS FOR OSTWALD RIPENING PROCESSES
Razi A. Hassan *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 07D

N91-19010*# Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
A STUDY OF THE CURRENT GROUP EVAPORATION/COMBUSTION THEORIES
Hayley H. Shen *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21B

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N91-18242# Pacific Northwest Lab., Richland, WA.
ION IRRADIATION EFFECTS ON A MARTENSITIC STAINLESS STEEL DESIGNED FOR REDUCED LONG-LIFE RADIOACTIVITY
Robin D. Griffin, Steven J. Zinkle, Richard A. Dodd, Gerald L. Kulcinski (Wisconsin Univ., Madison.), and David S. Gelles Apr. 1990 26 p Presented at the 15th International Symposium on Effects of Radiation on Materials, Nashville, TN, 17-22 Jun. 1990
(Contract DE-AC06-76RL-01830)

(DE91-005045; PNL-SA-18291; CONF-900623-24) Avail: NTIS HC/MF A03

Alloys with reduced long-life radioactivity (low activation alloys) are being developed to increase the acceptability of fusion power. The phase stability and swelling resistance of a 12Cr-6.5Mn-1W-0.3V-0.1C martensitic steel were evaluated by transmission electron microscopy following 3.8 MeV Fe(++) ion irradiation with and without He coimplantation. Ion irradiations were performed at 450, 550, and 650 C to approximately 10, 20, and 40 dpa. At 550 C, approximately 20 appm He/dpa was coimplanted with the 3.8 MeV Fe(++) ions. The specimens were examined at a depth approximately halfway between the surface and the mean ion range in order to minimize the influence of the surface and of injected ions. At all temperatures, M23C6, also present in the unirradiated structure, was the only precipitate present. A nonuniform distribution of loops also formed at all temperatures. After the 450 and 650 C irradiations, no voids were present. At 550 C, the helium did not appear to have much effect. Very few faceted voids formed. At 20 and 40 dpa some bubbles were found but their density was very low. At 650 C, a structure similar to a heavily over-tempered steel was produced by the irradiation. At 550 C recovery was seen to a lesser extent. Little to no recovery was seen at 450 C. DOE

N91-18243# Institut National des Sciences Appliquees, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.

STUDY OF RELAXATION PHENOMENA FOR DILUTED CARBON-IRON ALLOYS Ph.D. Thesis [ETUDE DES PHENOMENES DE RELAXATION DES ALLIAGES FER-CARBONE DILUES]

Jose Manual Rubianes 1990 218 p In FRENCH

(ISAL-90-0064; ETN-91-98587) Avail: NTIS HC/MF A10

The relaxation phenomena caused by carbon in high purity iron containing different carbon concentrations were studied. Internal friction and micro-deformation experiments were carried out. The analysis of experimental results showed an important dependence of Snoek relaxation intensity on the texture. The activation parameters were calulated. The results showed the the DESE (Dislocation Enhanced induced Snoek Effect) is a relaxation peak, in which interstitial carbon atoms and dislocations participate. Models showed that relaxation is caused by the reorientation of carbon elastic dipoles in the dislocation stress field. The relaxation instability during the first temperature rise is to be explained by epsilon phase precipitation, its reversion and cementite precipitation. ESA

N91-18244# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Metallurgie.

ALUMINUM HIGH STRENGTH MATERIAL BY MECHANICAL ALLOYING AND REACTION MILLING: BASICS OF PROCESSING AND MATERIAL CHARACTERIZATION

Hugo Schlich and Manfred Thumann Jul. 1990 89 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1249)

(DLR-FB-90-29; ISSN-0171-1342; ETN-91-98595) Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 29.50 Deutsche marks

Basic investigations on the production and consolidation of atomized, mechanically alloyed and atomized and additionally milled aluminum alloy powder are presented and correlated to the mechanical properties of the compacts. By optimization of the processing techniques and parameters, especially of degassing, treatment an improved strength at elevated temperatures was achieved. However, the ductibility is still low and further improvements are necessary. ESA

N91-18245# California Univ., Berkeley.

THE ALUMINIUM-SCANDIUM-LITHIUM-MAGNESIUM SYSTEM AS A POTENTIAL SOURCE OF SUPERPLASTICALLY FORMABLE ALLOYS Ph.D. Thesis

Roger Alan Emigh Jul. 1990 77 p Prepared in cooperation with California Univ., Berkeley. Lawrence Berkeley Lab.

(Contract DE-AC03-76SF-00098)

(DE91-005369; LBL-29355) Avail: NTIS HC/MF A05

Alloys from the aluminum lithium scandium magnesium system were cast and rolled for study. The goal is to evaluate this system for the development of superplastically formable, high strength alloys. Aluminum-scandium-magnesium alloys have shown potential as superplastic alloys. These alloys rely on small Al3Sc (ordered L1(sub 2)) precipitates for grain structure stabilization and strengthening. Additional precipitation strengthening is required to raise their strength to levels sufficient for aircraft applications. The addition of lithium provides this additional strengthening through the formation of Al3Li(delta prime). To produce the alloys studied in this research, a unique induction melting furnace was constructed that incorporates special features to produce aluminum-lithium alloys with low hydrogen content. The furnace also features a water cooled, copper casting mold to achieve a moderately rapid solidification rate. This is because the amount of scandium used (0.5 wt percent) is in excess of the solubility limit and Al3Sc cannot be re-solutionized to any extent. It is therefore desired to super-saturate the matrix with as much scandium as possible for later precipitation. Two high lithium alloys were produced, ALS2 (nominal composition Al-2.2Li-O.5 Sc) and ALS4 (nominal composition Al-2.0Li-2.2Mg-0.5Sc) that were strengthened with delta prime (Al3Li). These alloys exhibited strength and ductility superior to those of aluminum-lithium-(magnesium)-zirconium alloys. This is because the scandium containing alloys have developed a finer grain structure and the Al3Sc precipitates contribute to the alloys strength. DOE

N91-18246# Oak Ridge National Lab., TN. Metals and Ceramics Div.

EFFECT OF ALUMINUM CONCENTRATION AND BORON DOPANT ON ENVIRONMENTAL EMBRITTLEMENT IN FeAl ALUMINIDES

C. T. Liu and E. P. George 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990

(Contract DE-AC05-84OR-21400)

(DE91-005450; CONF-901105-43) Avail: NTIS HC/MF A02

The room-temperature tensile properties of FeAl aluminides were determined as functions of aluminum concentration (35 to 43 at. percent Al), test environment, and surface (oil) coating. The two lower aluminum alloys containing 35 and 36.5 percent Al are prone to severe environmental embrittlement, while the two higher aluminum alloys with 40 and 43 percent Al are much less sensitive to change in test environment and surface coating. The reason for the different behavior is that the grain boundaries are intrinsically weak in the higher aluminum alloys, and these weak boundaries dominate the low ductility and brittle fracture behavior of the 40 and 43 percent Al alloys. When boron is added to the 40 percent Al alloy as a grain-boundary strengthener, the environmental effect becomes prominent. In this case, the tensile ductility of the boron-doped alloy, just like that of the lower aluminum alloys, can be dramatically improved by control test environment (e.g., dry oxygen vs air). Strong segregation of boron to the grain boundaries, with a segregation factor of 43, was revealed by Auger analyses. DOE

N91-18247# Argonne National Lab., IL. Materials and Components Technology Div.

THE ROLE OF Zr AND Nb IN OXIDATION/SULFIDATION BEHAVIOR OF Fe-Cr-Ni ALLOYS

K. Natesan and D. J. Baxter (Inco Europe Ltd., Hereford, England) Nov. 1990 76 p

(Contract W-31-109-eng-38)

(DE91-005749; ANL/FE-90/2) Avail: NTIS HC/MF A05

Structural Fe-Cr-Ni alloys may undergo rapid degradation at elevated temperatures unless protective surface oxide scales are formed and maintained. The ability of alloys to resist rapid degradation strongly depends on their Cr content and the chemistry of the exposure environment. Normally, 20 wt percent Cr is required for service at temperatures up to 1000 C; the presence of sulfur,

however, inhibits formation of a protective surface oxide scale. The oxidation and sulfidation behavior of Fe-Cr-Ni alloys is examined over a wide temperature range (650 to 1000 C), with particular emphasis on the effects of alloy Cr content and the radiation of reactive elements such as Nb and Zr. Both Nb and Zr are shown to promote protective oxidation behavior on the 12 wt percent Cr alloy in oxidizing environments and to suppress sulfidation in mixed oxygen/sulfur environments. Additions of Nb and Zr at 3 wt percent level resulted in stabilization of Cr2O3 scale and led to a barrier layer of Nb- or Zr-rich oxide at the scale/metal interface, which acted to minimize the transport of base metal cations across the scale. Oxide scales were preformed in sulfur-free environments and subsequently exposed to oxygen/sulfur mixed-gas atmospheres. Preformed scales were found to delay the onset of breakaway corrosion. Corrosions test results obtained under isothermal and thermal cycling conditions are presented. DOE

N91-18248# Argonne National Lab., IL. Materials Science Div.
TENSILE STRENGTH AND CREEP RESISTANCE IN NANOCRYSTALLINE Cu, Pd, AND Ag
G. W. Nieman, J. R. Weertman (Northwestern Univ., Evanston, IL.), and R. W. Siegel Dec. 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 25-30 Nov. 1990
(Contract W-31-109-eng-38; NSF DMR-83-20157; NSF DMR-88-21571)
(DE91-006416; CONF-901105-73) Avail: NTIS HC/MF A02

Measurements of tensile strength and creep resistance have been made on bulk samples of nanocrystalline Cu, Pd and Ag consolidated from powders by cold compaction. Samples of Cu-Cu2O have also been tested. Yield strength for samples with mean grains sizes of 5 to 80 nm and bulk densities on the order of 95 percent of theoretical density are increased 2 to 5 times over that measured in pure, annealed samples of the same composition with micrometer grain sizes. Ductility in the nanocrystalline Cu has exceeded 6 percent true strain, however, nanocrystalline Pd samples were much less ductile. Constant load creep tests performed at room temperature at stresses of greater than 100 MPa indicate logarithmic creep. The mechanical properties results are interpreted to be due to grain size-related strengthening and processing flaw-related weakening. DOE

N91-18249# Argonne National Lab., IL. Materials and Components Technology Div.
EFFECT OF POSTDEPOSITION ANNEALING ON STRUCTURE AND CHEMISTRY OF THE TIN FILM/STEEL SUBSTRATE INTERFACES
A. Erdemir and C. C. Cheng (Inland Steel Co., Chicago, IL.) 1990 22 p Presented at the 37th National American Vacuum Society Symposium, Toronto, Ontario, 7-10 Oct. 1990
(Contract W-31-109-eng-38)
(DE91-006657; CONF-901035-15) Avail: NTIS HC/MF A03

This study deals with solid-state phase transformations occurring at interfaces between a TiN film and an AISI M50 steel substrate during post-deposition annealing at 500 and 1000 C. Cross-sectional transmission electron microscopy (XTEM) was used to investigate the nature of phase transformations at these interfaces. The TiN films were ion plated onto M50 steel with an initial Ti underlayer at 100 C. XTEM and electron-energy-loss spectroscopy of the interfaces indicated that the ion-plated Ti underlayers transformed into a TiC phase during annealing at 500 C and into a Ti(C,N) phase during annealing at 1000 C. In addition, the density of defects within grains was significantly reduced during annealing and the grains themselves became larger. DOE

N91-18250*# Clarkson Univ., Potsdam, NY. Dept. of Chemical Engineering.
EFFECT OF CONVECTION ON THE MICROSTRUCTURE OF A LAMELLAR EUTECTIC GROWING WITH A STEPPED INTERFACE
Jayshree Seth and W. R. Wilcox [1990] 17 p
(Grant NAG8-753)
(NASA-CR-187943; NAS 1.26:187943) Avail: NTIS HC/MF A03 CSCL 11F

A two dimensional model developed to study the influence of convective flow on the concentration field ahead of a growing lamellar eutectic is described when one phase projects out into the melt creating a stepped interface. The two dimensional convective flow field, which is periodic in the horizontal direction, was computed numerically using the software FLUENT. The velocity field generated due to the flow of melt over the steps was then incorporated into a finite difference scheme employed to solve the concentration field. The average interfacial composition was calculated and converted to lamellar spacing using the Jackson and Hunt minimum supercooling criterion. It was found that a stepped interface is more sensitive to convection than a planar interface. Author

N91-18251# Oak Ridge National Lab., TN. Environmental Science Div.
NON-DESTRUCTIVE ON-LINE MONITORING OF MIC (MICROBIALLY INFLUENCED CORROSION)
D. C. White, D. E. Nivens, M. W. Mittelman, J. Q. Chambers, J. M. H. King, and G. S. Sayler (Tennessee Univ., Knoxville.) 1990 19 p Presented at the NACE Corrosion 1991 Symposium, Cincinnati, OH, 11-15 Mar. 1991 Sponsored in part by GRI
(Contracts DE-AC05-84OR-21400; N00014-86-K-0275; N00014-87-K-0012; F49620-89-C-0023; GS-14-08-0001-G1482; NSF CHE-87-18057; EPRI Proj. RP-3015-1; EPRI Proj. RP-8011-2)
(DE90-017770; CONF-910328-1) Avail: NTIS HC/MF A03

The formation of microbial biofilms on metal surfaces with the subsequent increase in heat transfer resistance and the induction of microbially influenced corrosion (MIC) is being increasingly recognized as an extremely important economic and safety problem for industrial water systems. The development of sufficiently rugged and accurate monitoring devices by which biofilm formation and activity of microbial biofilms can be monitored non-destructively, directly in water systems is the goal of this research. This on-line system would allow the effective utilization of minimal levels of biocides and inhibitors as well as permit in situ testing of materials for MIC resistance. Several non-destructive technologies such as the quartz crystal microbalance (QCM), the attenuated total reflectance-Fourier transforming infrared spectrometer (ATR-FT/IR), and a genetically engineered bacterium containing the lux gene cassette in which its bioluminescence can be used to define its presence on coupons are on-line devices which accurately measure biofilm formation. Corrosion activity can be estimated by electrochemical impedance. DOE

N91-18252# Argonne National Lab., IL. Materials Science Div.
THERMAL SPIKE MODEL OF ION-INDUCED GRAIN GROWTH
Dale E. Alexander and Gary S. Was (Michigan Univ., Ann Arbor.) Nov. 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990
(Contract W-31-109-eng-38; NSF DMR-86-03174; NSF DMR-89-03138)
(DE91-006571; CONF-901105-77) Avail: NTIS HC/MF A02

A thermal spike model has been developed to describe the phenomenon of ion irradiation-induced grain growth in metal alloy thin films. In single phase films where the driving force for grain growth is the reduction of grain boundary curvature, the model shows that ion-induced grain boundary mobility, M(sub ion), is proportional to the quantity F(sub D) squared/Delta H(sub coh) cubed, where F(sub D) is the deposited ion damage energy and Delta H(sub coh) is the cohesive energy of the element or alloy. Experimental strain growth results from ion irradiated coevaporated binary alloy films compare favorably with model predictions. DOE

N91-18253# Argonne National Lab., IL. Materials Science Div.
MULTIDISCIPLINARY STUDY OF PHASE SEPARATION IN A SUPERSATURATED NI-SI ALLOY
Haydn Chen (Illinois Univ., Urbana.) and J. E. Epperson Jul.

1990 13 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society on Physical Metallurgy and Materials in Conjunction with Materials Week and the Material Applications and Services Exposition, Detroit, MI, 7-11 Oct. 1990
(Contracts W-31-109-eng-38; DE-AC02-76ER-01198; DE-AC02-80ER-10744)
(DE91-006586; CONF-901008-9) Avail: NTIS HC/MF A03

The subject of gamma prime precipitation in a Ni-12.5 at. percent Si alloy was studied by modern diffraction and scattering techniques in the small-angle and large angle regimes, and by transmission electron microscopy. Special attention is placed upon the mechanism and kinetic evolution of gamma prime precipitates as a function of ageing conditions. Methods are shown for the determination of interdiffusion coefficient, the interfacial energy and the coherent solubility. The strain effect, due to lattice mismatch, on the spatial correlation and preferred alignment of precipitates is addressed. Scaling law for the particle growth has been tested against the current theories. Results obtained from the three mutually beneficial techniques are shown to be consistent, thereby allowing an integral view of the phase separation process in this system. DOE

N91-18254# Sandia National Labs., Albuquerque, NM.
MEASUREMENTS OF To TEMPERATURES OF SUPERSATURATED Si-As ALLOYS
Kwang-Ryeol Lee, Jeffrey A. West, Patrick M. Smith, M. J. Aziz (Harvard Univ., Cambridge, MA.), and J. A. Knapp 1990 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC04-76DP-00789)
(DE91-006774; SAND-90-2831C; CONF-901105-80) Avail: NTIS HC/MF A02

The congruent melting point, to T(o) curve, of crystalline Si-As alloys has been measured in the range of 1.6 to 18.1 at. percent arsenic by line source electron beam annealing. Alloys were created by ion implantation of As into 0.1 mm Si-on-sapphire and crystallized by pulsed laser melting. T(o) temperatures decrease from 1673 +/-10 K at 2.0 at. percent As to 1516 +/-30K at 18.1 at. percent As. The results of these measurements are significantly higher than the previous results of studies using pulsed laser melting techniques. Advantages of the e-beam technique over previous techniques are discussed. Chemical free energy functions of the solid and liquid phases were calculated from existing thermodynamic data. The calculated T(o) curve agrees with the measured values only in low concentration region (less than 8 at. percent). DOE

N91-18255# Pacific Northwest Lab., Richland, WA.
METASTABLE PHASE FORMATION IN Be-Nb INTERMETALLIC COMPOUNDS
J. L. Brimhall, L. A. Charlot, and S. M. Bruemmer Nov. 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990 Submitted for publication Sponsored by ONR
(Contract DE-AC06-76RL-01830)
(DE91-005617; PNL-SA-18395; CONF-901105-50) Avail: NTIS HC/MF A02

Amorphous structures or metastable crystalline phases are produced in sputter deposited Beryllium-Niobium (Be-Nb) alloys (5 to 15 at. percent Nb) depending on the substrate temperature. The metastable phases transform to the stable Be12Nb, Be17Nb2Nb phases on annealing at temperatures greater than 800 C. No Be5Nb phase was found and the Be17Nb2 phase is stable to low temperature. The Be12Nb phase appeared to have a stoichiometric range of about 5.5 to 7.7 at. percent Nb. The formation of the metastable phases is consistent with current models and theories. DOE

N91-18256# Westinghouse Savannah River Co., Aiken, SC.
INITIAL REPORT ON MOLECULAR MODELING OF METAL HYDRIDES
Khalid A. Mansour and Ralph J. Wolf Dec. 1990 16 p Revised
(Contract DE-AC09-89SR-18030)
(DE91-005747; WSRC-TR-90-156-REV-1) Avail: NTIS HC/MF A03

Metal hydrides are for hydrogen/tritium storage and handling. Examples of such metals and metal alloys include palladium (Pd) and lanthanum-nickel-aluminum (LaNiAl). These materials have the unique properties of being hydrogen/tritium 'sponges'. Metal hydrides absorb enormous quantities of hydrogen/tritium, where the hydrogen density is much larger than in liquid hydrogen. There is a unique problem that develops in tritium storage, mainly due to its radioactive decay into helium. Helium is inert (i.e., non-reactive due to its closed shell electronic structure) and tends to remain in the hydride once it forms there. A clear understanding of such a phenomenon (and how to minimize it and possibly get rid of it) is the foundation of our current work. Our main focus is to fundamentally understand hydrogen/tritium behavior and interactions in these metals, so that we can design better and more efficient tritium handling materials and facilities. As a by-product of this work, we will be able to apply our state-of-the-art techniques to study other problems involving hydrogen/tritium and helium in SRS materials. Examples include hydrogen and helium interactions in lithium-aluminum reactor targets, tritium reservoirs, and stainless steel reactor tanks. DOE

N91-18257# Los Alamos National Lab., NM.
CHEMICAL BONDING OF HYDROGEN MOLECULES TO TRANSITION METAL COMPLEXES
Gregory J. Kubas 1990 15 p Presented at the International Symposium on Metal-Hydrogen Systems, Banff, Alberta, 2-7 Sep. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE91-005852; LA-UR-90-4336; CONF-9009141-8) Avail: NTIS HC/MF A03

The complex W(CO)3(PR3)2(H2) (CO = carbonyl; PR3 = organophosphine) was prepared and was found to be a stable crystalline solid under ambient conditions from which the hydrogen can be reversibly removed in vacuum or under an inert atmosphere. The weakly bonded H2 exchanges easily with D2. This complex represents the first stable compound containing intermolecular interaction of a sigma-bond (H-H) with a metal. The primary interaction is reported to be donation of electron density from the H2 bonding electron pair to a vacant metal d-orbital. A series of complexes of molybdenum of the type Mo(CO)(H2)(R2PCH2CH2-PR2)2 were prepared by varying the organophosphine substitutent to demonstrate that it is possible to bond either dihydrogen or dihydride by adjusting the electron-donating properties of the co-ligands. Results of infrared and NMR spectroscopic studies are reported. DOE

N91-18258# State Univ. of New York, Buffalo.
COMPARISON OF GROUP TRANSFER, INNER SPHERE, AND OUTER SPHERE ELECTRON TRANSFER MECHANISMS OF ORGANOMETALLIC COMPLEXES
J. D. Atwood 1990 9 p
(Contract DE-FG02-87ER-13775)
(DE91-005933; DOE/ER-13775/2) Avail: NTIS HC/MF A02

During the course of Grant ER13775 we have constructed an infrared stopped-flow spectrophotometer and initiated a study of the mechanisms of reactions that involve a change in the oxidation state of organometallic complexes. The spectrometer combined conventional stopped-flow techniques with an infrared optical system comprised of a carbon monoxide laser, an IRTRAN flow-through cell and a mercury-cadium-telluride detector. In this summary we will highlight our results on reactions: (1) that formally involve exchange of a charged species between two metal carbonyl anions, (2) that involve additional of an electron to, or removal of an electron from organometallic complexes that contain a metal-metal bond, and (3) between coordination complexes and metal carbonyl anions. DOE

N91-18259# Argonne National Lab., IL. Materials Science Div.
OPTICAL DETERMINATION OF THE OXYGEN STOICHIOMETRY OF NANOPHASE METAL-OXIDE MATERIALS
J. C. Parker (Nanophase Technologies Corp., Evanston, IL.) and R. W. Siegel Oct. 1990 7 p Presented at the Acta Metallurgica Conference on Materials With Ultrafine Microstructures, Atlantic City, NJ, 1-5 Oct. 1990 Submitted for publication
(Contract W-31-109-eng-38)
(DE91-006364; CONF-9010292-1) Avail: NTIS HC/MF A02

An overview and assessment is presented of the use of optical techniques, primarily Raman scattering, for analyzing the composition and stoichiometry of nanophase metal-oxide ceramics. Raman scattering was shown to be a useful technique for evaluating the oxygen stoichiometry of some metal oxide materials. However, it is essential for nanophase materials that grain size effects are considered since their ultrafine grain sizes can produce large shifting and broadening of the Raman spectrum. DOE

N91-18260# Argonne National Lab., IL. Materials Science Div.
MECHANICAL BEHAVIOR OF NANOCRYSTALLINE METALS
G. W. Nieman, J. R. Weertman (Northwestern Univ., Evanston, IL.), and R. W. Siegel Oct. 1990 7 p Presented at the Acta Metallurgica Conference on Materials with Ultrafine Microstructures, Atlantic City, NJ, 1-5 Oct. 1990 Submitted for publication
(Contract W-31-109-eng-38; NSF DMR-83-20157; NSF DMR-88-21571)
(DE91-006422; CONF-9010292-4) Avail: NTIS HC/MF A02

The influence of grain size or cell size on the mechanical behavior of metals is well known, although debate continues about details of defect control mechanisms. In the past, difficulty in producing bulk samples with grain sizes smaller than about 1 (mu)m limited mechanical behavior studies in finer-grained materials. Expressions relating strength to grain size, determined from studies of coarse-grained materials, suggest that reducing grain size into the sub-micrometer range results in increased mechanical strength at low homologous temperatures. At high temperatures, diffusional creep effects may lead to increased ductility. This paper reports the major results to date of an ongoing study of the mechanical behavior of nanocrystalline metals produced by the inert-gas condensation method; some results have been reported elsewhere. Studies of the tensile strength, low-temperature creep and Vickers microhardness of Cu, Pd and Ag reported here are complemented in this broader study by processing studies, x ray grain-size and strain analyses, and high resolution microscopy studies of nanostructure and microstructure. The work provides a basis for predicting low-temperature mechanical behavior of ultrafine-grained metals, subject to some significant constraints imposed by the processing conditions.
DOE

N91-18261# Argonne National Lab., IL.
KINETIC ENERGY OF HYDROGEN IN BETA-V2H STUDIED BY NEUTRON COMPTON SCATTERING
R. Hempelmann, D. Richter (Forschungszentrum Juelich G.m.b.H., Germany, F.R.), and D. L. Price Aug. 1990 11 p Presented at the International Symposium on Metal-Hydrogen Systems, Banff, Alberta, 2-7 Sep. 1990 Sponsored in part by Australian International Science and Technology Program
(Contract W-31-109-eng-38)
(DE91-006589; CONF-9009141-9) Avail: NTIS HC/MF A03

Hydrogen dissolves in nearly all metals in large quantities, occupying interstitial sites which are energetic minima of the hydrogen potential. Experimentally, this potential can be determined by neutron vibrational spectroscopy (NVS) and, recently, by neutron Compton scattering (NCS) i.e., either by a measurement of the excitation energies of the localized hydrogen vibrations or by a measurement of the hydrogen momentum distribution. In this brief communication we report on what we believe is the first NCS experiment on a metal hydride. For the system to be investigated beta-V2H, an ordered hydride phase with hydrogen on pseudotetragonal octahedral sites was chosen. DOE

N91-18262# Oak Ridge National Lab., TN.
MICROWAVE SINTERING OF ZIRCONIA-TOUGHENED ALUMINA COMPOSITES
H. D. Kimrey, J. O. Kiggans, M. A. Janney, and R. L. Beatty 1990 15 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE91-007185; CONF-900466-99) Avail: NTIS HC/MF A03

The feasibility of firing zirconia-alumina composites has been demonstrated. Techniques have been developed whereby virtually any composition of ZTA can be fired in 2.45- and 28-GHz microwave fields. Comparing data from conventional and microwave firing shows that the sintering temperature can be as much as 500 C lower for the microwave case. A reduction in sintering temperature, as suspected, appears to result in a significant decrease in the grain size in the microstructure. Apparently, the path of microstructural change is altered so that densification can proceed with little coarsening as an interfering mechanism. The microwave effect appears to be a function of frequency. Our results give some indication of why the microwave effect was not seen earlier at 2.45 GHz. Technological problems associated with producing uniform fields interfere and in this case mask the microwave effect. With larger cavities and perhaps more clever insulation schemes, it may be possible to reproduce the results in 2.45 GHz that are seemingly so easily achieved at higher frequency. DOE

N91-18018# Wichita State Univ., KS. Dept. of Mechanical Engineering.
STUDY OF THE AGING AND DEFORMATION CHARACTERISTICS OF Al-Li ALLOYS BY X-RAY ANALYSIS Abstract Only
V. Gondhalekar, A. Inchekel, J. Chaudhuri, and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 17 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18019# Wichita State Univ., KS. Dept. of Mechanical Engineering.
ASSESSMENT OF MATERIAL PARAMETERS GOVERNING THE PLASTIC DEFORMATION IN UNIAXIAL TENSION OF Al-Li ALLOYS Abstract Only
A. Inchekel and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 18 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18977*# Southern Univ., Baton Rouge, LA. Dept. of Mechanical Engineering.
A STUDY OF HYDROGEN ENVIRONMENT EFFECTS ON MICROSTRUCTURE PROPERTY BEHAVIOR OF NASA-23 ALLOY AND RELATED ALLOY SYSTEMS
Ravinder M. Diwan *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

N91-19017*# California Polytechnic State Univ., San Luis Obispo. Dept. of Materials Engineering.
CHARACTERIZATION OF THE CORROSION RESISTANCE OF SEVERAL ALLOYS TO DILUTE BIOLOGICALLY ACTIVE SOLUTIONS
Daniel W. Walsh *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

N91-19020*# Utah State Univ., Logan. Dept. of Industrial Technology.
CHARACTERIZATION OF WELDED HP 9-4-30 STEEL FOR THE ADVANCED SOLID ROCKET MOTOR
George William Watt *In* Alabama Univ., Research Reports:

1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N91-18263# Department of the Navy, Washington, DC.
LOW TEMPERATURE SYNTHESIS OF HIGH PURITY MONOCLINIC CELSIAN USING TOPAZ Patent Application
Inna G. Talmy, inventor (to Navy) and Deborah A. Haught, inventor (to Navy) 7 Sep. 1990 10 p
(AD-D014712; US-PATENT-APPL-SN-580012;
NAVY-CASE-72941) Avail: NTIS HC/MF A02 CSCL 07/1

This invention relates to ceramics and more particularly to aluminosilicate ceramics. Ceramics based on monoclinic celsian (BaO-Al2O3-2SiO2) can be considered for applications requiring materials with a combination of high melting point, low thermal expansion, high thermal shock resistance, high-frequency working capabilities, low and thermally stable dielectric constant and low loss tangent. A process for preparing monoclinic celsian from topaz and BaCO3, powders by heating an intimate mixture of the powders at a temperature of from 900 degree C to less then 1590 degree C in an atmosphere of the gases generated by the monoclinic celsian formation reaction itself is described. GRA

N91-18264# Department of the Navy, Washington, DC.
LOW TEMPERATURE SYNTHESIS OF HIGH PURITY MONOCLINIC CELSIAN Patent Application
Inna G. Talmy, inventor (to NAVY) and Deborah A. Haught, inventor (to Navy) 13 Sep. 1990 20 p
(AD-D014715; US-PATENT-APPL-SN-582269;
NAVY-CASE-71820) Avail: NTIS HC/MF A03 CSCL 07/3

A process for preparing monoclinic celsian from AlF3, Al203, BaCO3, and fused SiO2 powders by heating an intimate mixture of the powders (1) at from about 700 to 900 C to form topaz, and then (2) at a temperature as low as 900 C to produce monoclinic celsian. The reactions take place in an atmosphere of the gases generated by the reactions. GRA

N91-18265# Oak Ridge National Lab., TN.
DEFECT GENERATION AND MOTION IN POLYETHYLENE-LIKE CRYSTALS, ANALYZED BY SIMULATION WITH SUPERCOMPUTERS
Bernhard Wunderlich, A. Xenopoulos, D. W. Noid, and B. G. Sumpter (Tennessee Univ., Knoxville.) 1990 13 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC05-84OR-21400; NSF DMS-88-18412)
(DE91-004770; CONF-901105-31) Avail: NTIS HC/MF A03

Defects in polymers were observed by high resolution electron microscopy and inferred from their mechanical and dielectrical behavior. The details of their generation was not known, however, in the past. During the last few years we have been able to extend the molecular dynamics simulation of polyethylene to crystals containing up to 6100 atoms and to times as long as 100 ps. The major observation was that single bond rotations of more than 90(degree) become possible already more than 100 K below the melting temperature. These defects have lifetimes of only a few ps. By coupling to kinks (2g1) they can extend their lifetime considerably. Addition of a thermal, mechanical or dielectric free energy gradient to the thermally created defects seems to be able to account for the microscopic motion needed to explain the macroscopically observed annealing, deformations and relaxation effects. Key to the mechanical and dielectric properties is thus the existence of conformational disorder (condis crystal). DOE

N91-18266# Oregon State Univ., Corvallis. Dept. of Physics.
STUDYING OXYGEN VACANCIES IN CERAMICS BY PERTURBED ANGULAR CORRELATION SPECTROSCOPY
Han-Tzong Su, Ruiping Wang, Heinz Fuchs, John A. Gardner, William E. Evenson, and James A. Sommers (Teledyne Wah Chang, Albany, NY.) 1990 28 p
(Contract DE-FG06-85ER-45191)
(DE91-005568; DOE/ER-45191/15) Avail: NTIS HC/MF A03

Perturbed angular correlation measurements in tetragonal and cubic zirconia and in ceria are described. A physically reasonable and self-consistent interpretation of these data implies that oxygen vacancies are trapped at a second neighbor position by Cd in tetragonal zirconia and by In in ceria. For Cd in tetragonal zirconia, the vacancy trap energy is found to be 0.44 eV, and the energy barrier between adjacent trap sites is approximately 0.8 eV. The activation energy of an oxygen vacancy hopping between trap sites around (sup 111)Cd in ceria is found to be 0.55 eV. The activation energy for oxygen vacancy hopping in cubic zirconia, as detected by (sup 181)Ta PAC, is about 1.0 eV and independent of the Y concentration. DOE

N91-18267# Oregon State Univ., Corvallis. Dept. of Physics.
PERTURBED ANGULAR CORRELATIONS IN ZIRCONIA CERAMICS Annual Progress Report
1990 8 p Prepared in cooperation with Teledyne Wah Chang, Albany, NY
(Contract DE-FG06-85ER-45191)
(DE91-005571; DOE/ER-45191/12) Avail: NTIS HC/MF A02

This is the progress report for the first year of the currently-approved three year funding cycle. We have carried on a vigorous program of experimental and theoretical research on microscopic properties of zirconia and ceria using the Perturbed Angular Correlation (PAC) experimental technique. The experimental method was described in the original proposal and in a number of references as well as several of the technical reports that accompany this progress report. DOE

N91-18268# Ford Motor Co., Dearborn, MI. Powertrain and Materials Research Lab.
SYNTHESIS OF HIGH PURITY SINTERABLE Si3N4 POWDERS Final Report
G. M. Crosbie, R. L. Predmesky, and J. M. Nicholson Aug. 1990 82 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE91-005637; ORNL/SUB-85-SB012/1) Avail: NTIS HC/MF A05

To meet the needs of silicon nitride ceramics for vehicle applications, a vapor-SiCl(sub 4) liquid ammonia process was further developed to pre-pilot scale for synthesis of equi-axed Si3N4 powders via a silicon diimide intermediate. In this Ceramic Technology for Advanced Heat Engines (CTAHE) project, control of the ordinarily exothermic reaction was achieved without organic contaminants through use of the vapor under pressure to allow operation near room temperature. In this report, the pre-pilot plant, its development, and operation are described. Then, characteristics are given for the low-oxygen imide intermediate, thermal decomposition, and the equi-axed, high alpha/(alpha+beta) nitride product powder. In spite of oxygen contamination, the powder sintered at ambient pressure to 88 percent of theoretical density. Finally, based on experience with the pre-pilot plant, process features are discussed in terms of yield, non-clogging of the chloride inlet, agitation speed, chloride removal at low temperature, lack of corrosion, and parameters that are needed for continuous flow designs. A comparison is drawn with the pressurized liquid-chloride--liquid-ammonia process, which is described in an appendix. DOE

N91-18269# Pacific Northwest Lab., Richland, WA.
INTERFACIAL CHEMISTRY AND STRUCTURE IN CERAMIC COMPOSITES
Russell H. Jones, Natalio T. Saenz, and C. H. Schilling Sep. 1990 42 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society on Physical Metallurgy and Materials

in Conjunction with Materials Week and the Material Applications and Services Exposition, Detroit, MI, 7-11 Oct. 1990
(Contract DE-AC06-76RL-01833)
(DE91-005676; PNL-SA-18133; CONF-901008-8) Avail: NTIS HC/MF A03

The interfacial chemistry and structure of ceramic matrix composites (CMCs) play a major role in the properties of these materials. Fiber-matrix interfaces chemistries are vitally important in the fracture strength, fracture toughness, and fracture resistance of ceramic composites because they influence fiber loading and fiber pullout. Elevated-temperature properties are also linked to the interfacial characteristics through the chemical stability of the interface in corrosive environments and the creep/pullout behavior of the interface. Physical properties such as electrical and thermal conductivity are also dependent on the interface. Fiber-matrix interfaces containing a 1 micron thick multilayered interface with amorphous and graphitic C to a 1 nm thick SiO2 layer can result from sintering operations for some composite systems. Fibers coated with C, BN, C/BC/BN, and Si are also used to produce controlled interface chemistries and structures. Growth interfaces within the matrix resulting from processing of CMCs can also be crucial to the behavior of these materials. Evaluation of the interfacial chemistry and structure of CMCs requires the use of a variety of analytical tools, including optical microscopy, scanning electron microscopy, Auger electron spectroscopy, and transmission electron microscopy coupled with energy dispersive x ray analysis. A review of the interfacial chemistry and structure of SiC whisker- and fiber-reinforced Si3N4 and SiC/SiC materials is presented. Where possible, correlations with fracture properties and high temperature stability are made. DOE

N91-18270# Pacific Northwest Lab., Richland, WA.
METALLOGRAPHIC PREPARATION TECHNIQUES FOR CERAMIC MATERIALS
Natalio T. Saenz Oct. 1990 10 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society on Physical Metallurgy and Materials in Conjunction with Materials Week and the Material Applications and Services Exposition, Detroit, MI, 8-11 Oct. 1990
(Contract DE-AC06-76RL-01830)
(DE91-004742; PNL-SA-18470; CONF-901008-6) Avail: NTIS HC/MF A02

With the increasing use of ceramic materials in many industrial areas, applied metallographic sample preparation techniques are used to produce true microstructural detail in ceramic materials. Due to the extreme hardness, porosity and brittleness of ceramic materials, improper ceramic preparation techniques tend to cause intergranular relief, grain plucking, grain fracturing, or other undesirable effects. Because of these inherent characteristics, care must be taken in the preparation of ceramic material. For example, defects such as cracking of the specimen can be initiated during the sectioning step and can also occur if improper mounting procedures are used. Pullout of grains which result from improper sectioning or a grinding technique that is too severe can also cause problems in later stages of preparation. To minimize any defects or a false microstructure, the metallographer must not only preform each step of sample preparation accurately, but must also have a clear understanding of the intended purpose for each specific sequence of preparation steps. DOE

N91-18271# Northwestern Univ., Evanston, IL. Dept. of Chemistry.
APPLICATION FOR CONTINUATION OF MIXED IONIC AND ELECTRONIC CONDUCTIVITY IN POLYMERS Progress Report, 1 Jan. - 31 Sep. 1990
D. F. Shiver and M. A. Ratner 1990 3 p
(Contract DE-FG02-85ER-45220)
(DE91-005077; DOE/ER-45220/T3) Avail: NTIS HC/MF A01

The aim in this portion of the research is to prepare new electroactive films with high ion mobility, and to characterize the transport properties of these materials. The classic conducting polymers, polyacetylene, polythiophene, and polypyrrole have dense structures that prevent rapid redox switching because of the low diffusivity of ions. The objective is to modify the last two polymers with pendant polyethers, which should greatly improve ion transport. DOE

N91-18272# Argonne National Lab., IL. Materials Science Div.
ELECTRON TRAPPING IN AMORPHOUS SILICON: A QUANTUM MOLECULAR DYNAMICS STUDY
Lin H. Yang, Rajiv K. Kalia, and Priya Vashishta Dec. 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-20 Apr. 1990
(Contract W-31-109-eng-38)
(DE91-006008; CONF-900466-95) Avail: NTIS HC/MF A02

Quantum molecular dynamics (QMD) simulations provide the real-time dynamics of electrons and ions through numerical solutions of the time-dependent Schroedinger and Newton equations, respectively. Using the QMD approach we have investigated the localization behavior of an excess electron in amorphous silicon at finite temperatures. For time scales on the order of a few picoseconds, we find the excess electron is localized inside a void of radius approximately 3 A at finite temperatures. DOE

N91-18273# Argonne National Lab., IL. Materials Science Div.
MEASUREMENTS OF GRAIN BOUNDARY PROPERTIES IN NANOCRYSTALLINE CERAMICS
Y. M. Chiang, I. P. Smyth, C. D. Terwilliger, W. T. Petuskey (Arizona State Univ., Tempe.), and J. A. Eastman Nov. 1990 7 p Presented at the Acta Metallurgica Conference on Materials With Ultrafine Microstructures, Atlantic City, NJ, 1-5 Oct. 1990
(Contracts W-31-109-eng-38; N00014-85-K-0645; NSF DMR-87-19217)
(DE91-006662; CONF-9010292-2) Avail: NTIS HC/MF A02

The advent of nanocrystalline ceramics prepared by a variety of solution-chemical and vapor deposition methods offers a unique opportunity for the determination grain boundary properties by bulk thermodynamic methods. Results are discussed from two types of measurements on model nanocrystalline ceramics. The first is a solution thermodynamic measurement of the activity of nanocrystalline SiC in polycarbosilane-derived silicon carbide fibers (Nicalon). Structural studies have shown that Nicalon consists of well ordered cubic (beta or 3C polytype) SiC grains separated by a very thin grain boundary layer (less than 1 nm thick) containing the oxygen. The physical properties and chemical reactivity of these fibers are distinctly different from that of bulk silicon carbide. Direct measurement of the alloy composition and analysis of the microstructure has allowed the dissolution reaction to be identified and a lower limit for the SiC activity in the nanocrystalline form to be determined. A second method of measuring grain boundary properties was investigated for nanocrystalline Si and TiO2 is high temperature calorimetry. In appropriate samples the grain boundary enthalpy can be measured through the heat evolved during grain growth. Preliminary results on nanocrystalline Si prepared by the recrystallization of amorphous evaporated films and on TiO2 condensed from the vapor phase are discussed. DOE

N91-18274# Argonne National Lab., IL.
IMPURITY-DEFECT COMPLEXES IN HYDROGENATED AMORPHOUS SILICON
Lin H. Yang, C. Y. Fong, and C. S. Nichols (Cornell Univ., Ithaca, NY.) Nov. 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract W-31-109-eng-38)
(DE91-006765; CONF-901105-82) Avail: NTIS HC/MF A02

The two most outstanding features observed for dopants in hydrogenated amorphous silicon (a-Si:H) - a shift in the Fermi level accompanied by an increase in the defect density and an absence of degenerate doping - have previously been postulated to stem from the formation of substitutional dopant-dangling bond complexes. Using first-principles self-consistent pseudopotential calculation in conjunction with a supercell model for the amorphous network and the ability of network relaxation from the first-principles results, we have studied the electronic and structural properties of substitutional fourfold-coordinated phosphorus and boron at the

second neighbor position to a dangling bond defect. We demonstrate that such impurity-defect complexes can account for the general features observed experimentally in doped a-Si:H. DOE

N91-18275# Missouri Univ., Kansas City.
THEORETICAL STUDIES ON THE ELECTRONIC STRUCTURE AND PROPERTIES OF COMPLEX CERAMIC CRYSTALS AND GLASSES Annual Report, 1 Jul. 1990 - 30 Jun. 1991
Wai-Yim Ching 10 Jan. 1991 9 p
(Contract DE-FG02-84ER-45170)
(DE91-006814; DOE/ER-45170/7) Avail: NTIS HC/MF A02

This progress report summarizes the research activities for the period July 1, 1990 to June 30, 1991, the first year of a three-year renewal. The major accomplishments for the current year are: study of electronic structures and optical properties of several important ceramic crystals such as Y2O3, Al2O3, MgO, MgAl2O4, ZrO2, V2O3, V2O5 and all polycrystalline forms of SiO2; theoretical study on superconducting oxides; first-principles calculation of total energies and structural phase transitions in oxides and nitrides; basic study on metallic glasses including calculation of transport properties; and theory of rare-earth and transition metal compounds. The major thrust for the next year's effort will be concentrating on the following: continuation of electronic and optical studies of important ceramic systems. Particular emphasis will be on the total energy calculations on complex crystals such as various polymorphic forms of SiO2, ZrO2, and Si3N4; fundamental studies on the structure and properties of different phases of Boron and B-related compounds; and further development of the OLCAO method such as application of self-interaction correction to wide gap insulators, spin-polarized calculations on the magnetic glasses and extraction of effective interatomic pair potentials for simulational studies. DOE

N91-18276# Argonne National Lab., IL. Materials Science Div.
INTERDIFFUSION AT THE BILAYER POLYMER INTERFACE: EVIDENCE FOR REPTATION
G. P. Felcher, A. Karim, and T. P. Russell (International Business Machines Corp., San Jose, CA.) Jun. 1990 18 p Presented at the International Discussion Meeting on Relaxation in Complex System, Heraklion, Greece, 18-29 Jun. 1990
(Contract W-31-109-eng-38)
(DE91-004405; CONF-9006294-1) Avail: NTIS HC/MF A03

Neutron reflection is used to study the interdiffusion in equal molecular weight polystyrene bilayer melts with a spatial resolution of 1 nm. Interfacial widths and concentration profiles at the bilayer interface are obtained for annealing times up to and beyond the time (reptation time, tau sub d) in which the molecule has moved by its own length. For annealing times t less than (tau sub d), the reptation model predicts a mean square displacement of monomers whose time evolution is a power law. The detailed profile is expected to exhibit a discontinuity (sharp gradient) of density at the interface between the two polymers. For relatively light weight polymers of M approx 233,000, the mean square displacements of monomers is in general agreement with reptation predictions; the discontinuity at the interface is only observed when the molecular weights are large, M approx 1,000,000. The discontinuity is present even for low concentrations of the deuterated polymer where isotopic slowing down effects are negligible, thus confirming the sharp gradient as being due to reptation. DOE

N91-18277# Sandia National Labs., Albuquerque, NM.
MICROCELLULAR FOAMS PREPARED FROM DEMIXED POLYMER SOLUTIONS
J. H. Aubert 1990 11 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990
(Contract DE-AC04-76DP-00789)
(DE91-004816; SAND-90-2931C; CONF-901105-49) Avail: NTIS HC/MF A03

Low-density, microcellular polymer foams have numerous applications as structural supports in high-energy physics experiments, in catalysis, ion exchange, and filtration, and for a variety of biomedical uses. A versatile method to prepare such foams is by thermally-induced phase separation (TIPS) of polymer solutions. Demixed solutions can be transformed into a foam by freezing the demixed solution and removing the solvent by freeze-drying. The morphology of these foams is determined by the thermodynamics and kinetics of phase separation. A model of both the early and late stage structure development for demixed polymer solutions will be presented. For semi-crystalline polymers, gels can be prepared by crystallizing the polymer from solution, either a homogeneous solution or a demixed solution. Foams can be prepared from these gels by the supercritical extraction of the solvent. By understanding and utilizing the phase separation behavior of polymer solutions, engineered microcellular foams can be prepared. To design the foams for any application one must be able to characterize their morphology. Results will be presented on the morphological characterization of these foams and the relationship of the morphology to their processing history. DOE

N91-18278# Argonne National Lab., IL. Materials Science Div.
IS SUPERPLASTICITY IN THE FUTURE OF NANOPHASE MATERIALS
R. W. Siegel Jul. 1990 13 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, 16-21 Apr. 1990 Submitted for publication
(Contract W-31-109-eng-38)
(DE91-006079; CONF-900466-96) Avail: NTIS HC/MF A03

The ultrafine grain sizes and high diffusivities in nanophase materials assembled from atomic clusters suggest that these materials may have a strong tendency toward superplastic mechanical behavior. Both small grain size and enhanced diffusivity can be expected to lead to increased diffusional creep rates as well as to a significantly greater propensity for grain boundary sliding. Recent mechanical properties measurements at room temperature on nanophase Cu, Pd, and TiO2, however, give no indications of superplasticity. Nonetheless, significant ductility has been clearly demonstrated in these studies of both nanophase ceramics and metals. The synthesis of cluster-assembled nanophase materials is described and the salient features of what is known of their structure and mechanical properties is reviewed. Finally, the answer to the question posed in the title is addressed. DOE

N91-18279# MSE, Inc., Butte, MT.
CERAMIC FABRICATION R AND D Quarterly Report, 1 Apr. - 30 Jun. 1990
1990 37 p
(Contract DE-AC07-88ID-12735)
(DE91-006536; DOE/ID-12735/T12) Avail: NTIS HC/MF A03

This project is separated into three tasks. The first task is a design and modeling effort to be carried out by MSE, Inc. The purpose of this task is to develop and analyze designs for various cohesive ceramic fabrication (CCF) components, including an MHD electrode for strategic defense initiative (SDI) applications and a high stress, low cost, reinforced ceramic component for armor applications. The MHD electrode design is substantially completed. A layered structure composed of molybdenum disilicide graded with quartz glass has been designed and analyzed using finite element methods. The design demonstrates the fabrication capabilities of the CCF process. The high stress, armor application component will be silicon carbide reinforced alumina in thick plates. DOE

N91-18280# National Aeronautical Lab., Bangalore (India). Materials Science Div.
INVESTIGATIONS ON THE PROBLEM OF MOISTURE ABSORPTION BY KEVLAR FIBRES: EFFECT OF RELATIVE HUMIDITY OF THE ATMOSPHERE AND THE DEGREE OF CRYSTALLINITY OF THE FIBRES
H. V. Parimala, M. Shubha, and Kalyani Vijayan Oct. 1990 14 p
(NAL-PD-MT-9015) Avail: NTIS HC/MF A03

The effects of relative humidity (RH) of the ambient atmosphere and the degree of crystallinity of fibers on the process of moisture uptake by Kevlar 49 fibers was investigated. For RH values ranging

from 3 to 80 percent, variation of the moisture content of the initially dry fibers with time was measured. It was found that the saturation moisture content varies with the RH value. Specimens in which crystallinity was reduced by appropriate treatment exhibit a marked increase in the moisture content. Experiments on the effect of soaking the fibers in water at 26 degrees and 98 degrees C were also carried out. Author

N91-18281# Pacific Northwest Lab., Richland, WA.
BONE FORMATION: THE RULES FOR FABRICATING A COMPOSITE CERAMIC
A. I. Caplan (Case Western Reserve Univ., Cleveland, OH.) Jan. 1990 6 p Presented at the Materials Research Society Fall Meeting, Boston, 27 Nov. - 2 Dec. 1989
(Contract DE-AC06-76RL-01830)
(DE91-005178; PNL-SA-17902; CONF-891119-144) Avail: NTIS HC/MF A02

Bone, teeth and shells are complex composite ceramics which are fabricated at low temperature by living organisms. The detailed understanding of this fabrication process is required if this low temperature assembly process is to be mimicked. The guiding principles and major components are outlined with the intent of establishing non-vital fabrication schemes to form a complex composite ceramic consisting of an organic matrix inorganic crystalline phase. DOE

N91-18282# Pacific Northwest Lab., Richland, WA.
SYNTHETIC SURFACES AS MODELS FOR BIOMINERALIZATION SUBSTRATES
P. C. Rieke, B. J. Tarasevich, S. B. Bentjen, T. S. Autrey, and D. A. Nelson Jan. 1990 13 p Presented at the Materials Research Society Fall Meeting, Boston, 27 Nov. - 2 Dec. 1989
(Contract DE-AC06-76RL-01830)
(DE91-005182; PNL-SA-17303; CONF-891119-143) Avail: NTIS HC/MF A03

Polyethylene and oxide substrates were derivatized with functional groups commonly associated with biomineralization substrates. These groups include carboxylate, phosphate, hydroxy, sulfonate, thiol, and amine. Fourier transform infrared spectroscopy, x ray photoelectron spectroscopy, and contact angle wetting were used to identify and characterize the products at each step. The efficacy of these groups toward inducing mineralization will be compared with naturally occurring substrates. DOE

N91-18283# Argonne National Lab., IL.
THE ROLE OF SOFT (METALLIC) FILM IN TRIBOLOGICAL BEHAVIOR OF CERAMIC MATERIALS
O. O. Ajayi, A. Erdemir, R. A. Erck, G. R. Fenske, and F. A. Nichols 1990 26 p Presented at the International Conference on Wear of Materials, Orlando, FL, 7-11 Apr. 1991
(Contract W-31-109-eng-38)
(DE91-006003; CONF-910437-1) Avail: NTIS HC/MF A03

The friction coefficient and wear rate in structural ceramic materials are often too high to make them attractive for applications requiring dry sliding. The role of a thin soft silver film in improving the tribological characteristics of silicon nitride materials is investigated in this study. In a pin-on-disc contact configuration in reciprocating motion, the friction coefficient was reduced by about 50 percent and the wear rate by one to two orders of magnitude. The friction reduction is thought to be due to the reduction of the contact interface shear strength by the presence of the soft film. The wear rate reduction is likely due to modification of the contact stresses by the film. Combined, these two factors lead to a decrease in the magnitude of the damaging tensile stresses. The durability and thus the effectiveness of the film is very dependent on the bond strength (i.e., adhesion strength) between the film and the substrate. DOE

N91-18284# Lawrence Livermore National Lab., CA.
IONIC TWO PHOTON STATES AND OPTICAL NONLINEARITY IN (pi)-CONJUGATED POLYMERS
S. N. Dixit, D. Guo, and S. Mazumdar (Arizona Univ., Tucson.) Nov. 1990 11 p Presented at the Symposium on Photoinduced Charge Transfer in Molecular Crystals and Liquid Crystals, Rochester, 6-9 Jun. 1990
(Contract W-7405-eng-48)
(DE91-006709; UCRL-JC-103634; CONF-9006218-2) Avail: NTIS HC/MF A03

A microscopic mechanism of optical nonlinearity in (pi)-conjugated polymers is presented. It is shown that the bulk of the nonlinearity is determined by only two well defined channels, even though an infinite number of channels are possible in principle. The above conclusion is true for both short and long range Coulomb interactions. The complete frequency dependence of the third harmonic generation in both trans-polyacetylene and polydiacetylene are explained within the same theoretical picture. DOE

N91-18285# Sandia National Labs., Albuquerque, NM.
DEVELOPMENT OF KEVLAR PARACHUTE WEBBINGS
R. H. Ericksen 1991 9 p Presented at the 11th AIAA Aerodynamic Decelerator Systems Technology Conference, San Diego, 9-11 Apr. 1991
(Contract DE-AC04-76DP-00789)
(DE91-007513; SAND-90-2306C; CONF-9104171-4) Avail: NTIS HC/MF A02

This paper describes the development of Kevlar webbings for parachute applications. Evaluation of existing webbings and a study of the effects of filling yarn denier and pick count on tensile and joint strength provided data for fabric design. Measurements of warp crimp as a function of filling denier and pick count demonstrated the relationship between warp crimp and strength. One newly developed webbing had higher strength efficiency and another had higher joint efficiency than comparable existing webbings. Both new webbings had overall efficiencies over 5 percent higher than values for existing webbings. DOE

N91-18302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DIAMONDLIKE CARBON AS A MOISTURE BARRIER AND ANTIREFLECTING COATING ON OPTICAL MATERIALS
John A. Woollam, Bhola N. De, L. Y. Chen (Nebraska Univ., Lincoln.), John J. Pouch, and Samuel A. Alterovitz *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 232-237 Sponsored in part by Control Data Corp. (For primary document see N91-18297 10-32)
(Contract NAG3-154; DAAL04-86-C-0030)
Avail: NTIS HC/MF A13 CSCL 11C

N91-18303*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THIN FILM CHARACTERIZATION USING SPECTROSCOPIC ELLIPSOMETRY
Samuel A. Alterovitz *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 238 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N91-18286# Lawrence Livermore National Lab., CA.
UNDERSTANDING COMPOSITE EXPLOSIVE ENERGETICS. PART 1: THE ROLE OF METALLIC ADDITIVES
William C. Tao, Craig M. Tarver, Don R. Breithampt, Raymond R. McGuire, and Don L. Ornellas 1990 12 p Presented at the 14th Symposium on Explosives and Pyrotechnics, Burlingame, CA, 13-15 Feb. 1990 Previously announced in IAA as A90-49921

(Contract W-7405-eng-48)
(DE90-010692; UCRL-102581; CONF-900254-3) Avail: NTIS HC/MF A03

Composite explosives (CE) have found major applications in air blast, cratering, fragmentation, underwater applications, and other commercial and military systems in which prompt delivery of the available energy is not a primary requirement. In direct metal acceleration applications, composite explosives have not generally been effective because their potential energy is transformed to kinetic energy over time periods extending to tens of microseconds. We are interested in defining the rate determining steps and understanding the chemical interactions between different components in the composite explosive formulation in order to determine the partitioning of the available energy. In this study, we investigate the role of the metallic additive in a bicomponent composite explosive consisting of PETN and aluminum. Of specific interests are the early time performance of and the extent of aluminum reaction in the composite formulation. For formulations loaded with 5 wt percent and 10 wt percent of 5 micron spherical aluminum, we found that 100 percent of the aluminum reacted within the first microsecond of volume expansion. The extent of aluminum reaction with the PETN detonation products is reduced to about 65 percent for composite formulations loaded with 20 wt percent aluminum. It is evident from the results of a series of scaling experiments that the detonation behavior of the PETN-aluminum bicomponent composite explosive is nonideal. DOE

N91-18287# Materials Research Labs., Ascot Vale (Australia).
ASSESSMENT OF HAZARD PROPERTIES OF TETRYL REPLACEMENT FORMULATIONS
John Pisani 1990 19 p
(MRL-TR-90-21) Copyright Avail: NTIS HC/MF A03

Pilot production batches of three RDX/wax compositions proposed as replacements for tetryl in fuze systems were assessed for hazardous properties and sensitivity. All were found to be less sensitive to impact and electrostatic spark than tetryl, and to have similar sensitivity to friction. Their response to thermal stimuli, including cookoff, was similar to RDX. Shock sensitivity, as assessed by small scale gap test, was in the required range for their proposed applications. The pilot production materials retained their characteristics after twelve months accelerated environmental exposure. Material from one full scale production batch was also tested and found to be similar to the equivalent pilot production material. Author

N91-18288*# Thiokol Corp., Brigham City, UT. Space Operations
TP-H1148 KNITLINE INTEGRITY EVALUATION Final Report
M. Gill Nov. 1990 43 p
(Contract NAS8-30490)
(NASA-CR-184106; NAS 1.26:184106; TWR-18755) Avail: NTIS HC/MF A03 CSCL 21I

The main objective was to reevaluate the TP-H1148 propellant knitting capabilities due to minor changes in TP-H1148 raw materials and to test the effects of aging on the knitline and the bondline of the propellant to the liner (when epoxy primer was applied). Y.S.

N91-18289*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
IGNITION AND COMBUSTION CHARACTERISTICS OF METALLIZED PROPELLANTS Semiannual Report, Jun. - Dec. 1989
S. R. Turns, D. C. Mueller, and M. J. Scott Jan. 1990 25 p
(Grant NAG3-1044)
(NASA-CR-187951; NAS 1.26:187951) Avail: NTIS HC/MF A03 CSCL 21I

Research designed to develop detailed knowledge of the secondary atomization and ignition characteristics of aluminum slurry propellants was started. These processes are studied because they are the controlling factors limiting the combustion efficiency of aluminum slurry propellants in rocket applications. A burner and spray rig system allowing the study of individual slurry droplets having diameters from about 10 to 100 microns was designed and fabricated. The burner generates a near uniform high temperature environment from the merging of 72 small laminar diffusion flames above a honeycomb matrix. This design permits essentially adiabatic operation over a wide range of stoichiometries without danger of flashback. A single particle sizing system and velocimeter also were designed and assembled. Light scattered from a focused laser beam is related to the particle (droplet) size, while the particle velocity is determined by its transit time through the focal volume. Light from the combustion of aluminum is also sensed to determine if ignition was achieved. These size and velocity measurements will allow the determination of disruption and ignition times as functions of drop sizes and ambient conditions. Author

N91-18290# Union Carbide Corp., South Charleston, WV. Industrial Chemicals Div.
DIRECT CONVERSION OF METHANE TO C2'S AND LIQUID FUELS Final Technical Progress Report, 1 Oct. 1987 - 31 Dec. 1989
Barbara Knight Warren, Kenneth D. Campbell, J. L. Matherne, G. L. Culp, and N. E. Kinkade 15 Apr. 1990 405 p
(Contract DE-AC22-87PC-79817)
(DE91-005868; DOE/PC-79817/8) Avail: NTIS HC/MF A18

Conversion of methane to liquid hydrocarbon transportation fuels in an energy efficient, economical process would represent important technology for extending natural hydrocarbon fuel reserves. Methane coupling catalysts were explored which are the first reported catalyst to provide hundreds of hours of stable operation in the oxidation of methane to C(sub 2)'s with high ethylene to ethane product ratios (2.5 to 10 or more). These catalysts contain alkaline earth components and require the presence of small amounts of halides, either as a catalysts component or as a periodic or continuous additive to the catalyst. Other classes of catalysts studied include simple perovskites, layered perovskites, metal/molecular sieves, hydrotalcites, catalysts based on Pr/Ce oxygen carriers, low temperature silver catalysts, low temperature catalysts containing certain Group VIII metals, and superacids (in the cofeed mode), and a unique class of sequential mode double perovskites coupling catalysts. Methane coupling products from low pressure coupling reactions (less than 25 psig) were olgomerized to liquid hydrocarbons without separation and/or compression of the product stream. Economic assessments were completed for several cases of methane coupling for a comparison case where gasoline and distillate fuels are produced: (1) from methane using conventional technology involving reforming; and (2) from methane to gasoline and distillate fuels using methane coupling technology. DOE

N91-18291# Los Alamos National Lab., NM.
CHARADE: A CHARACTERISTIC CODE FOR CALCULATING RATE-DEPENDENT SHOCK-WAVE RESPONSE
J. N. Johnson and D. L. Tonks Jan. 1991 117 p
(Contract W-7405-eng-36)
(DE91-006791; LA-11993-MS) Avail: NTIS HC/MF A06

In this report we apply spatially one-dimensional methods and simple shock-tracking techniques to the solution of rate-dependent material response under flat-plate-impact conditions. This method of solution eliminates potential confusion of material dissipation with artificial dissipative effects inherent in finite-difference codes, and thus lends itself to accurate calculation of elastic-plastic deformation, shock-to-detonation transition in solid explosives, and shock-induced structural phase transformation. Equations are presented for rate-dependent thermoelastic-plastic deformation for zone axes (100) planar shock-wave propagation in materials of cubic symmetry (or higher). Specific numerical calculations are presented for polycrystalline copper using the mechanical threshold stress model of Follansbee and Kocks with transition to dislocation drag. A listing of the CHARADE (for characteristic rate dependence) code and sample input deck are given. DOE

N91-18292# Oak Ridge National Lab., TN.
THE FEDERAL METHANOL FLEET: SUMMARY OF TECHNICAL DATA
R. N. McGill, R. L. Graves, B. H. West, and J. W. Hodgson (Tennessee Univ., Knoxville.) Apr. 1991 7 p Presented at the 9th International Symposium on Alchol Fuels, Florence, Italy, Apr. 1991
(Contract DE-AC05-84OR-21400)
(DE91-006608; CONF-9104162-1) Avail: NTIS HC/MF A02

The Federal Methanol Fleet, initiated in 1985 with an appropriation from the U.S. Congress, is now in its final stages of operation. A great deal has been learned while vehicles have accumulated approximately 1.4 million miles (2.2 million kilometers) in routine government fleet service. This paper summarizes those results that are technical in nature and that reveal the status of methanol engine technology. Specifically, results from emissions test, special lubricant tests, and cold-starting experiments are reported herein. Emissions control systems in methanol vehicles were found generally to decline somewhat in performance over time as compared to their gasoline counterpart vehicles, although this was not universally true. The severe effects on methanol engine lubricant performance resulting from cold-engine, short-trip service was demonstrated in a series of special tests of two cars, methanol and gasoline, in side-by-side service. Methanol fleet vehicles incorporated a variety of approaches to the cold-start problem -- ranging from no special engineering or systems to sophisticated systems designed to overcome the problem entirely. Cold-start systems specially designed for these vehicles did not perform as well as had been expected, probably because they were early prototype versions and were subject to some early, unforeseen problems. DOE

N91-18079# Department of National Defence, Ottawa (Ontario). Operational Research and Analysis Establishment.
EVALUATION OF A NEW FUEL WITH HIGHER ENERGY DENSITY
P. E. Desmier and R. R. Hastings *In* AGARD, Progress in Military Airlift Dec. 1990 17 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N91-18293*# Alabama Univ., Huntsville. Center for Microgravity and Materials Research.
EVALUATION OF ADVANCED LIGHT SCATTERING TECHNOLOGY FOR MICROGRAVITY EXPERIMENTS Final Technical Progress Report, 1 Jul. 1988 - 31 Dec. 1990
W. J. Fredericks and W. M. Rosenblum 31 Dec. 1990 31 p
(Grant NAG8-733)
(NASA-CR-187965; NAS 1.26:187965) Avail: NTIS HC/MF A03 CSCL 22A

The capabilities of modern light scattering equipment and the uses it might have in studying processes in microgravity are evaluated. Emphasis is on the resolution of polydisperse systems. This choice was made since a major use of light scattering was expected to be the study of crystal growth of macromolecules in low gravity environments. An evaluation of a modern photon correlation spectrometer and a Mie spectrometer is presented.
Author

N91-18122*# Alabama Univ., Huntsville.
FLUID PHASE SEPARATION (FPS) EXPERIMENT FOR FLIGHT ON THE SHUTTLE IN A GET AWAY SPECIAL (GAS) CANISTER: DESIGN AND FABRICATION
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 3-10 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

N91-18159*# Worcester Polytechnic Inst., MA.
INTEGRATED SUPPORT STRUCTURE FOR GASCAN 2
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 255-264 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

N91-19008*# Christian Brothers Coll., Memphis, TN. Dept. of Mechanical Engineering.
VALIDATION OF THE SPACE SHUTTLE MAIN ENGINE STEADY STATE PERFORMANCE MODEL
L. Michael Santi *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 9 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N91-18294# Lawrence Livermore National Lab., CA.
ELECTROPLATING, ELECTROLESS PLATING AND ELECTROFORMING
J. W. Dini Feb. 1990 9 p Presented at the SUR/FIN '90: 77th American Electroplaters and Surface Finishers Society Annual Technical Conference, Boston, MA, 9-12 Jul. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005399; UCRL-JC-103324; CONF-9007145-3) Avail: NTIS HC/MF A02

This presentation is intended to familiarize non-platers with electrolytic and electroless deposition techniques and how these methods are used to manufacture non-reinforced metal parts by the electroforming process. The techniques enable manufacture of complex shapes, often at lower cost than other forming methods. Electroless techniques are deposition methods which provide uniform deposits of very low porosity without the use of electrical current. In electroforming, the part is formed by deposition on a mandrel or preform, from which it is subsequently separated.
DOE

N91-18295# Sandia National Labs., Albuquerque, NM. Fluid Mechanics and Heat Transfer Div.
A CENTRAL REFRIGERATION SYSTEM TO SUPPORT MULTIPLE ENVIRONMENTAL TEST CHAMBERS: DESIGN, DEVELOPMENT, AND EVALUATION
R. G. Baca, K. M. Miller, and K. L. Shipley Nov. 1990 51 p
(Contract DE-AC04-76DP-00789)
(DE91-004997; SAND-89-0629) Avail: NTIS HC/MF A04

A pilot plant project was undertaken to develop a central refrigeration compressor station capable of providing the necessary cooling to a network of nine independently-controlled environmental test chambers operating at temperatures of minus 85 F to 350 F. Design features of the central two-stage (cascade) vapor compression refrigeration system are described. Computer control of the central refrigeration station is a major contribution to the improved efficiency of the overall system. A second computer-control system was developed to perform the task of environmental chamber control, test management, and chamber performance monitoring. Data on performance of the Climatic Central Refrigeration System (CCRS) are presented. DOE

N91-18296# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
THE COLLABORATIVE PROGRAM OF RESEARCH IN ENGINEERING SCIENCE
Dec. 1990 273 p Prepared in cooperation with Idaho National

Engineering Lab., Idaho Falls, ID
(Contract DE-FG02-85ER-13331)
(DE91-006741; DOE/ER-13331/T2) Avail: NTIS HC/MF A12

MIT and Idaho National Engineering Laboratory are continuing the program of collaborative research on energy-related engineering. The program involves research in the following areas: (1) mathematical modeling of thermal plasma systems, (2) high-temperature gas-particle reactions, (3) metal transfer in gas-metal arc welding, (4) multivariate control of gas-metal arc welding, (5) fundamentals of elastic-plastic fracture, (6) communition of energy materials, and (7) synthesis and optimization of integrated chemical processes. A key objective of this collaborative program is to serve as a prototype for other university/laboratory collaborative programs. Another important goal is to enhance the transfer of new technology to the industrial sector. DOE

N91-18015# Wichita State Univ., KS. Dept. of Mechanical Engineering.
USE OF NATURAL PARTICLES FOR THE REMOVAL OF PAINT FROM AERONAUTICAL COMPOSITE MATERIALS
Abstract Only
Thu-Ha Guy, Hamid M. Lankarani, and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 14 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18132*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
BAGGING SYSTEM, SOIL STABILIZATION MAT, AND TENT FRAME FOR A LUNAR BASE
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 63-67 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

N91-18135*# Idaho Univ., Moscow.
PRELIMINARY GREENHOUSE DESIGN FOR A MARTIAN COLONY: STRUCTURAL, SOLAR COLLECTION, AND LIGHT DISTRIBUTION SYSTEMS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 89-92 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

N91-18149*# Prairie View Agricultural and Mechanical Coll., TX.
REPLENISHABLE FOOD SUPPLY ON MARS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 183-186 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

N91-19001*# Lenoir-Rhyne Coll., Hickory, NC. Dept. of Physics and Earth Science.
A SURVEY OF TECHNIQUES FOR REFRIGERATION, RELIQUEFACTION, AND PRODUCTION OF SLUSH FOR HYDROGEN
Dan R. Overcash *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13B

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N91-18297*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLID STATE TECHNOLOGY BRANCH OF NASA LEWIS RESEARCH CENTER SECOND ANNUAL DIGEST, JUNE 1989 - JUNE 1990
Jun. 1990 289 p
(NASA-TM-103226; E-5642; NAS 1.15:103226) Avail: NTIS HC/MF A13 CSCL 20L

A collection of papers and presentations authored by the branch between June 1989 and June 1990 is presented. The papers are organized into four sections. Section 1 deals with research in microwave circuits and includes full integrated circuits, the demonstration of optical/RF interfaces, and the evaluation of some hybrid circuitry. Section 2 indicates developments in coplanar waveguides and their use in breadboard circuits. Section 3 addresses high temperature superconductivity and includes: thin film deposition, transport measurement of film characteristics, RF surface resistant measurements, substrate permittivity measurements, measurements of microstrip line characteristics at cryogenic temperatures, patterning of superconducting films, and evaluation of simple passive microstrip circuitry based on YBaCuO films. Section 4 deals with carbon films, silicon carbide, GaAs/AlGaAs, HgCdTe, and other materials. For individual titles, see N91-18298 through N91-18306.

N91-18298*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA DEVELOPMENTS IN SOLID STATE POWER AMPLIFIERS **c33**
Regis F. Leonard *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 3-10 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 09A

Over the last ten years, NASA has undertaken an extensive program aimed at development of solid state power amplifiers for space applications. Historically, the program may be divided into three phases. The first efforts were carried out in support of the advanced communications technology satellite (ACTS) program, which is developing an experimental version of a Ka-band commercial communications system. These first amplifiers attempted to use hybrid technology. The second phase was still targeted at ACTS frequencies, but concentrated on monolithic implementations, while the current, third phase, is a monolithic effort that focusses on frequencies appropriate for other NASA programs and stresses amplifier efficiency. The topics covered include: (1) 20 GHz hybrid amplifiers; (2) 20 GHz monolithic MESFET power amplifiers; (3) Texas Instruments' (TI) 20 GHz variable power amplifier; (4) TI 20 GHz high power amplifier; (5) high efficiency monolithic power amplifiers; (6) GHz high efficiency variable power amplifier; (7) TI 32 GHz monolithic power amplifier performance; (8) design goals for Hughes' 32 GHz variable power amplifier; and (9) performance goals for Hughes' pseudomorphic 60 GHz power amplifier. K.S.

N91-18299*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SURFACE AND IMPLANTATION EFFECTS ON p-n JUNCTIONS **c76**
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 201-204 (For primary document see

N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

The contribution of the graded region of implanted p-n junctions is analyzed using an exponential profile. Though previously neglected, it was recently shown that this contribution to the saturation current of HgCdTe diodes is significant. Assuming a dominant Auger recombination, an analytical solution to the continuity equation is obtained. An expression for the current generation by the graded region is presented for both ohmic and reflecting boundary conditions. A revised condition for a wide region is derived. When the region is narrow, the current differs drastically from that of the zero-gradient case. The effects of the junction depth and the substrate and surface concentrations on the current are investigated. It is shown that the reverse current does not saturate. Author

N91-18300*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROPERTIES OF INSULATOR INTERFACES WITH p-HgCdTe c76
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 205-207 Repr. from Journal of Vacuum Science Technology, v. 8, no. 2, Mar./Apr. 1990 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

Heat treatment at 70 C of low carrier concentration p-type HgCdTe samples (p sub o = 8 x 10 exp 14/cm) generates an inverted surface layer. A two day anneal process below 95 C did not affect the Hall coefficient, whereas an almost complete recovery was obtained by annealing at 120 C. While bulk electron mobility, obtained from PEM data, remained high (about 9 x 10 exp 4 sq cm/V s at 77 K), surface mobility is lower by more than an order of magnitude. Surface recombination velocity indicates a continuous improvement with increased temperature, and the activation energy remains equal to the vacancies energy level. The proposed mechanism is that of positive changes in the sulfide migrating towards the interface and generating an image inversion layer. Author

N91-18301*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SURFACE ELECTRONS IN INVERTED LAYERS OF p-HgCdTe c76
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 208-214 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

Anodic oxide passivation of p-type HgCdTe generates an inversion layer. Extremely high Hall mobility data for electrons in this layer indicated the presence of a two-dimensional electron gas. This is verified by use of the Shubnikov-de Haas effect from 1.45 to 4.15 K. Data are extracted utilizing a numerical second derivative of dc measurement. Three sub-bands are detected. Their relative occupancies are in excellent agreement with theory and with experimental results obtained on anodic oxide as accumulation layers of n-type HgCdTe. The effective mass derived is comparable to what was expected. Author

N91-18302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DIAMONDLIKE CARBON AS A MOISTURE BARRIER AND ANTIREFLECTING COATING ON OPTICAL MATERIALS c27
John A. Woollam, Bhola N. De, L. Y. Chen (Nebraska Univ., Lincoln.), John J. Pouch, and Samuel A. Alterovitz *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 232-237 Sponsored in part by Control Data Corp. (For primary document see N91-18297 10-32)
(Contract NAG3-154; DAAL04-86-C-0030)
Avail: NTIS HC/MF A13 CSCL 11C

Diamondlike carbon (DLC) is amorphous, hard, semitransparent, and is under consideration for use as a coating material for infrared optics. DLC is also designated as a-C:H to indicate its amorphous nature as well as to indicate the presence of large (20 to 55 percent) amounts of hydrogen in the film. Two important questions arise with respect to use of DLC in infrared optics. Will the lack of grain boundaries help to keep moisture from penetrating the film. Secondly, application as an antireflection coating places restrictions on the allowed values of the index of refraction of the film relative to the particular substrate material being used. Will DLC have the correct index range. These two questions are addressed in this paper. Author

N91-18303*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THIN FILM CHARACTERIZATION USING SPECTROSCOPIC ELLIPSOMETRY c27
Samuel A. Alterovitz *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 238 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 11C

The application of the multiple angle and wavelength (MAW) technique to measure the dielectric function of semiconducting films is discussed. This technique evaluates unambiguously the complex dielectric function, epsilon (E), of the film without any pre-assumptions. In some cases the effective medium approximation (EMA) was used to determine the volume fraction of the film components. Application of the MAW technique to several semiconducting films was published previously. Different applications and examples are given, including metal and insulator films. Author

N91-18304*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ELLIPSOMETRIC STUDY OF CUBIC SiC Abstract Only c76
Samuel A. Alterovitz, Neil S. Shoemaker, and J. A. Powell *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 239 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

Variable angle spectroscopic ellipsometry (VASE) was applied to cubic SiC. This technique gives absolute values of the refractive index (n) and the extinction coefficient (k) of a substrate and/or a thin film of unknown material. The samples were grown by chemical vapor deposition (CVD) on p-type silicon. The substrate was aligned either on the (001) axis or 1 degree of (001). Several growth temperatures and growth durations were used. The samples were divided into two groups: (1) thick films of order 10 microns grown near optimal conditions of temperature, flow, and gas ratio; and (2) thin films of order 100 A grown at various temperatures. The ellipsometric results for samples in group 1 were analyzed using a two-phase model (substrate and ambient). Results show that for wavelengths in the visible, the refractive index of these CVD samples is equal to that reported for single crystal cubic SiC, within the experimental error, which is on the order of 1 percent. However, the extinction coefficient has a relatively large value, even above the band gap. The absorption is sample dependent and has a broad peak in the visible. The results for samples in group 2 were analyzed using a three-phase model (substrate, film, and ambient). The dielectric functions of the film, deducted from the measured n and k, were further analyzed using the effective medium approximation. The results show that the films contain 30 to 40 vol. percent amorphous silicon, i.e., silicon with only short-range order. Author

N91-18305*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL DISPERSION RELATIONS FOR DIAMONDLIKE CARBON FILMS c74
Samuel A. Alterovitz, Robert M. Sieg, Neil S. Shoemaker (Case

Western Reserve Univ., Cleveland, OH.), and John J. Pouch *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 240-245 Previously announced as N90-10738 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20F

Ellipsometric measurements on plasma deposited diamondlike amorphous carbon (a-C:H) films were taken in the visible, (E = 1.75 to 3.5 eV). The films were deposited on Si and their properties were varied using high temperature (up to 750 C) anneals. The real (n) and imaginary (k) parts of the complex index of refraction, N, were obtained simultaneously. Following the theory of Forouhi and Bloomer, a least squares fit was used to find the dispersion relations n(E) and k(E). Reasonably good fits were obtained, showing that the theory can be used for a-C:H films. Moreover, the value of the energy gap, Eg, obtained in this way was compared the the Eg value using conventional Tauc plots and reasonably good agreement was obtained. Author

N91-18306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DIAMONDLIKE CARBON APPLICATIONS IN INFRARED OPTICS AND MICROELECTRONICS c74
John A. Woollam, Bhola N. De, S. Orzeszko, N. J. Ianno, Paul G. Snyder, Samuel A. Alterovitz, John J. Pouch, R. L. C. Wu, and D. C. Ingram (Universal Energy Systems, Inc., Dayton, OH.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 246-276 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20F

The use of diamondlike carbon (DLC) as a protective coating in harsh environments is addressed. There are three topics presented. The first is a description of the preparation of DLC on seven different infrared transmitting materials, and the possibility of using DLC as an antireflecting coating at commonly used wavelengths. DLC doesn't bond easily to all materials, and special techniques for bonding are presented. The second topic deals with how well DLC will protect a substrate from moisture penetration. This is an important aspect in numerous uses of DLC, including both infrared optics and integrated circuits. The third topic is the effect of particulate impact on film performance and integrity. Author

N91-18307*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
SATCOM ANTENNA SITING STUDY ON A P-3C USING THE NEC-BSC V3.1
D. Bensman and R. J. Marhefka Apr. 1990 326 p
(Grant NAG2-542)
(NASA-CR-187949; NAS 1.26:187949; ESL-TR-721711-2) Avail: NTIS HC/MF A15 CSCL 20N

The location of a UHF SATCOM antenna on a P-3C aircraft is studied using the NEC-Basic Scattering Code V3.1 (NEC-BSC3). The NEC-BSC3 is a computer code based on the uniform theory of diffraction. The code is first validated for this application using scale model measurements. In general, the comparisons are good except in 10 degree regions near the nose and tail of the aircraft. Patterns for various antenna locations are analyzed to achieve a prescripted performance. Author

N91-18308*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Oct. - Dec. 1990
E. C. Posner, ed. 15 Feb. 1991 273 p
(NASA-CR-187940; NAS 1.26:187940; JPL-TDA-PR-42-104)
Avail: NTIS HC/MF A12 CSCL 17B

This quarterly reports on space communications, radio navigation, radio science, and ground based radio and radar astronomy in connection with the Deep Space Network (DSN) in planning, supporting research and technology, implementation, and in operations. Also included is standards activity at JPL for space data and information systems and DSN work. Specific areas of research are: Tracking and ground based navigation; Spacecraft and ground communications; Station control and system technology; DSN Systems Implementation; and DSN Operations. For individual titles, see N91-18309 through N91-18328.

N91-18309*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
DEMONSTRATION OF PRECISE ESTIMATION OF POLAR MOTION PARAMETERS WITH THE GLOBAL POSITIONING SYSTEM: INITIAL RESULTS c04
S. M. Lichten *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 1-8 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 17G

Data from the Global Positioning System (GPS) were used to determine precise polar motion estimates. Conservatively calculated formal errors of the GPS least squares solution are approx. 10 cm. The GPS estimates agree with independently determined polar motion values from very long baseline interferometry (VLBI) at the 5 cm level. The data were obtained from a partial constellation of GPS satellites and from a sparse worldwide distribution of ground stations. The accuracy of the GPS estimates should continue to improve as more satellites and ground receivers become operational, and eventually a near real time GPS capability should be available. Because the GPS data are obtained and processed independently from the large radio antennas at the Deep Space Network (DSN), GPS estimation could provide very precise measurements of Earth orientation for calibration of deep space tracking data and could significantly relieve the ever growing burden on the DSN radio telescopes to provide Earth platform calibrations. Author

N91-18310*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
ANALYSIS OF A THICK DICHROIC PLATE WITH RECTANGULAR HOLES AT ARBITRARY ANGLES OF INCIDENCE
J. C. Chen *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 9-16 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

A thick dichroic plate that is transparent to one frequency band while at the same time reflective to other frequencies is needed for high power transmission in the Deep Space Network. Software based on the method of moments was developed to design a thick dichroic plate with rectangular holes. A test dichroic plate was fabricated, and an experiment was performed to verify the computer code. Good agreement was found between theory and experiment. Author

N91-18311*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN ANALYSIS OF THE LEAST-SQUARES PROBLEM FOR THE DSN SYSTEMATIC POINTING ERROR MODEL
L. S. Alvarez *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 17-29 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

A systematic pointing error model is used to calibrate antennas in the Deep Space Network. The least squares problem is described and analyzed along with the solution methods used to determine the model's parameters. Specifically studied are the rank degeneracy problems resulting from beam pointing error measurement sets that incorporate inadequate sky coverage. A least squares parameter subset selection method is described and its applicability to the systematic error modeling process is demonstrated on Voyager 2 measurement distribution. Author

N91-18312*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
PREDICTIVE CONTROL AND ESTIMATION ALGORITHMS FOR THE NASA/JPL 70-METER ANTENNAS
W. Gawronski *In its* The Telecommunications and Data Acquisition

Report 15 Feb. 1991 p 30-49 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

A modified output prediction procedure and a new controller design is presented based on the predictive control law. Also, a new predictive estimator is developed to complement the controller and to enhance system performance. The predictive controller is designed and applied to the tracking control of the Deep Space Network 70 m antennas. Simulation results show significant improvement in tracking performance over the linear quadratic controller and estimator presently in use. Author

N91-18313*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
INITIAL STUDIES OF ARRAY FEEDS FOR THE 70-METER ANTENNA AT 32 GHz
P. W. Cramer *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 50-67 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

The results of a study to determine the feasibility of using array feed techniques to improve the performance of the 70 m antenna at 32 GHz are presented. Changing from 8.4 to 32 GHz has the potential of increasing the gain by 11.6 dB, but recent measurements indicate that additional losses of from 3 to 7 dB occur at 32 GHz, depending on the elevation angle. Array feeds were proposed to recover some of the losses by compensating for surface distortions that contribute to these losses. Results for both surface distortion compensation and pointing error correction are discussed. These initial studies, however, had one significant restriction: The mechanical finite element model was used to characterize the surface distortions, not the measured distortions from three angle holography data, which would be more representative of the actual antenna. Further work is required to provide for a more accurate estimate of performance that utilizes holography data and, in particular, one that evaluates the performance in the focal plane region of the antenna. Author

N91-18314*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
STEADY-STATE PHASE ERROR FOR A PHASE-LOCKED LOOP SUBJECTED TO PERIODIC DOPPLER INPUTS
C.-C. Chen and M. Z. Win *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 68-73 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

The performance of a carrier phase locked loop (PLL) driven by a periodic Doppler input is studied. By expanding the Doppler input into a Fourier series and applying the linearized PLL approximations, it is easy to show that, for periodic frequency disturbances, the resulting steady state phase error is also periodic. Compared to the method of expanding frequency excursion into a power series, the Fourier expansion method can be used to predict the maximum phase error excursion for a periodic Doppler input. For systems with a large Doppler rate fluctuation, such as an optical transponder aboard an Earth orbiting spacecraft, the method can be applied to test whether a lower order tracking loop can provide satisfactory tracking and thereby save the effect of a higher order loop design. Author

N91-18315*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
MAXIMUM-ENTROPY PROBABILITY DISTRIBUTIONS UNDER Lp-NORM CONSTRAINTS **c65**
S. Dolinar *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 74-87 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 12A

Continuous probability density functions and discrete probability mass functions are tabulated which maximize the differential entropy or absolute entropy, respectively, among all probability distributions with a given L sub p norm (i.e., a given pth absolute moment when p is a finite integer) and unconstrained or constrained value set. Expressions for the maximum entropy are evaluated as functions of the L sub p norm. The most interesting results are obtained and plotted for unconstrained (real valued) continuous random variables and for integer valued discrete random variables. The maximum entropy expressions are obtained in closed form for unconstrained continuous random variables, and in this case there is a simple straight line relationship between the maximum differential entropy and the logarithm of the L sub p norm. Corresponding expressions for arbitrary discrete and constrained continuous random variables are given parametrically; closed form expressions are available only for special cases. However, simpler alternative bounds on the maximum entropy of integer valued discrete random variables are obtained by applying the differential entropy results to continuous random variables which approximate the integer valued random variables in a natural manner. All the results are presented in an integrated framework that includes continuous and discrete random variables, constraints on the permissible value set, and all possible values of p. Understanding such as this is useful in evaluating the performance of data compression schemes. Author

N91-18316*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
COMPRESSED/RECONSTRUCTED TEST IMAGES FOR CRAF/CASSINI **c90**
S. Dolinar, K.-M. Cheung, I. Onyszchuk, F. Pollara, and S. Arnold *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 88-97 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 03B

A set of compressed, then reconstructed, test images submitted to the Comet Rendezvous Asteroid Flyby (CRAF)/Cassini project is presented as part of its evaluation of near lossless high compression algorithms for representing image data. A total of seven test image files were provided by the project. The seven test images were compressed, then reconstructed with high quality (root mean square error of approximately one or two gray levels on an 8 bit gray scale), using discrete cosine transforms or Hadamard transforms and efficient entropy coders. The resulting compression ratios varied from about 2:1 to about 10:1, depending on the activity or randomness in the source image. This was accomplished without any special effort to optimize the quantizer or to introduce special postprocessing to filter the reconstruction errors. A more complete set of measurements, showing the relative performance of the compression algorithms over a wide range of compression ratios and reconstruction errors, shows that additional compression is possible at a small sacrifice in fidelity. Author

N91-18317*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
EMERGING STANDARDS FOR STILL IMAGE COMPRESSION: A SOFTWARE IMPLEMENTATION AND SIMULATION STUDY **c61**
F. Pollara and S. Arnold *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 98-102 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 09B

The software implementation is described of an emerging standard for the lossy compression of continuous tone still images. This software program can be used to compress planetary images and other 2-D instrument data. It provides a high compression image coding capability that preserves image fidelity at compression rates competitive or superior to most known techniques. This software implementation confirms the usefulness of such data compression and allows its performance to be compared with other schemes used in deep space missions and for data based storage. Author

N91-18318*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
ALGEBRAIC GEOMETRIC CODES **c64**
M. Shahshahani *In its* The Telecommunications and Data

Acquisition Report 15 Feb. 1991 p 103-108 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 12A

The performance characteristics are discussed of certain algebraic geometric codes. Algebraic geometric codes have good minimum distance properties. On many channels they outperform other comparable block codes; therefore, one would expect them eventually to replace some of the block codes used in communications systems. It is suggested that it is unlikely that they will become useful substitutes for the Reed-Solomon codes used by the Deep Space Network in the near future. However, they may be applicable to systems where the signal to noise ratio is sufficiently high so that block codes would be more suitable than convolutional or concatenated codes. Author

N91-18319*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Systems Section.
OVERVIEW OF ARRAYING TECHNIQUES IN THE DEEP SPACE NETWORK
A. Mileant and S. Hinedi *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 109-139 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

Four different arraying schemes that can be used by the Deep Space Network are functionally discussed and compared. These include symbol stream combining (SSC), baseband combining (BC), carrier arraying (CA), and full spectrum combining (FSC). In addition, sibeband aiding (SA) is also included and compared even though it is not an arraying scheme, since it uses a single antenna. Moreover, combinations of these schemes are discussed, such as carrier arraying with sideband aiding and baseband combining (CA/SA/BC) or carrier arraying with symbol stream combining (CA/SSC). Complexity versus performance is traded off and the benefits to the reception of existing spacecraft signals are discussed. Recommendations are made as to the best techniques for particular configurations. Author

N91-18320*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
THE ADVANCED RECEIVER 2: TELEMETRY TEST RESULTS IN CTA 21 **c17**
S. Hinedi, R. Bevan, and M. Marina *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 140-156 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 14F

Telemetry tests with the Advanced Receiver II (ARX II) in Compatibility Test Area 21 are described. The ARX II was operated in parallel with a Block-III Receiver/baseband processor assembly combination (BLK-III/BPA) and a Block III Receiver/subcarrier demodulation assembly/symbol synchronization assembly combination (BLK-III/SDA/SSA). The telemetry simulator assembly provided the test signal for all three configurations, and the symbol signal to noise ratio as well as the symbol error rates were measured and compared. Furthermore, bit error rates were also measured by the system performance test computer for all three systems. Results indicate that the ARX-II telemetry performance is comparable and sometimes superior to the BLK-III/BPA and BLK-III/SDA/SSA combinations. Author

N91-18321*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Office of Telecommunications and Data Acquisition.
ON ESTIMATING THE PHASE OF A PERIODIC WAVEFORM IN ADDITIVE GAUSSIAN NOISE, PART 3
L. L. Rauch *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 157-160 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

Motivated by advances in signal processing technology that support more complex algorithms, researchers have taken a new look at the problem of estimating the phase and other parameters of a nearly periodic waveform in additive Gaussian noise, based on observation during a given time interval. Parts 1 and 2 are very briefly reviewed. In part 3, the actual performances of some of the highly nonlinear estimation algorithms of parts 1 and 2 are evaluated by numerical simulation using Monte Carlo techniques. Author

N91-18322*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Systems Section.
DIGITAL TEST SIGNAL GENERATION: AN ACCURATE SNR CALIBRATION APPROACH FOR THE DSN
B. O. Gutierrez-Luaces *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 161-174 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

A new method of generating analog test signals with accurate signal to noise ratios (SNRs) is described. High accuracy will be obtained by simultaneous generation of digital noise and signal spectra at a given baseband or bandpass limited bandwidth. The digital synthesis will provide a test signal embedded in noise with the statistical properties of a stationary random process. Accuracy will only be dependent on test integration time with a limit imposed by the system quantization noise (expected to be 0.02 dB). Setability will be approximately 0.1 dB. The first digital SNR generator to provide baseband test signals is being built and will be available in early 1991. Author

N91-18323*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Radio Frequency and Microwave Subsystems Section.
A COMPARISON OF MANCHESTER SYMBOL TRACKING LOOPS FOR BLOCK 5 APPLICATIONS
J. K. Holmes *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 175-191 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

The linearized tracking errors of three Manchester (biphase coded) symbol tracking loops are compared to determine which is appropriate for Block 5 receiver applications. The first is a nonreturn to zero (NRZ) symbol synchronizer loop operating at twice the symbol rate (NRZ x 2) so that it operates on half symbols. The second near optimally processes the mid-symbol transitions and ignores the between symbol transitions. In the third configuration, the first two approaches are combined as a hybrid to produce the best performance. Although this hybrid loop is the best at low symbol signal to noise ratios (SNRs), it has about the same performance as the NRZ x 2 loop at higher SNRs (greater than 0-dB E sub s/N sub 0). Based on this analysis, it is tentatively recommended that the hybrid loop be implemented for Manchester data in the Block 5 receiver. However, the high data rate case and the hardware implications of each implementation must be understood and analyzed before the hybrid loop is recommended unconditionally. Author

N91-18324*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Radio Frequency and Microwave Subsystems Section.
OPEN-LOOP FREQUENCY ACQUISITION FOR SUPPRESSED-CARRIER BIPHASE SIGNALS USING ONE-POLE ARM FILTERS
B. Shah and J. K. Holmes *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 192-210 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

Open loop frequency acquisition performance is discussed for suppressed carrier binary phase shift keyed signals in terms of the probability of detecting the carrier frequency offset when the arms of the Costas loop detector have one pole filters. The approach, which does not require symbol timing, uses fast Fourier transforms (FFTs) to detect the carrier frequency offset. The detection probability, which depends on both the 3 dB arm filter bandwidth and the received symbol signal to noise ratio, is derived and is shown to be independent of symbol timing. It is shown that the performance of this technique is slightly better that other open loop acquisition techniques which use integrators in the arms

and whose detection performance varies with symbol timing.
Author

N91-18325*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
FRAME SYNCHRONIZATION FOR THE GALILEO CODE
S. Arnold and L. Swanson *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 211-218 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

Results are reported on the performance of the Deep Space Network's frame synchronizer for the (15,1/4) convolutional code after Viterbi decoding. The threshold is found that optimizes the probability of acquiring true sync within four frames using a strategy that requires next frame verification. Author

N91-18326*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
PLANETARY EPHEMERIDES APPROXIMATION FOR RADAR ASTRONOMY **c89**
R. Sadr and M. Shahshahani *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 219-234 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 03A

The planetary ephemerides approximation for radar astronomy is discussed, and, in particular, the effect of this approximation on the performance of the programmable local oscillator (PLO) used in Goldstone Solar System Radar is presented. Four different approaches are considered and it is shown that the Gram polynomials outperform the commonly used technique based on Chebyshev polynomials. These methods are used to analyze the mean square, the phase error, and the frequency tracking error in the presence of the worst case Doppler shift that one may encounter within the solar system. It is shown that in the worst case the phase error is under one degree and the frequency tracking error less than one hertz when the frequency to the PLO is updated every millisecond. Author

N91-18327*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Systems Section.
NEW SPACE RESEARCH FREQUENCY BAND PROPOSALS IN THE 20- TO 40.5-GHz RANGE
D. F. Bishop *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 235-246 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

Future space research communications systems may require spectra above 20 GHz. Frequency bands above 20 GHz are identified that are suitable for space research. The selection of the proper bands depends on consideration of interference with other radio services, adequate bandwidths, link performance, and technical requirements for practical implementation. Author

N91-18328*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Spacecraft Telecommunications Equipment Section.
DESIGN CONCEPTS AND PERFORMANCE OF NASA X-BAND (7162 MHz/8415 MHz) TRANSPONDER FOR DEEP-SPACE SPACECRAFT APPLICATIONS
N. R. Mysoor, J. D. Perret, and A. W. Kermode *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 247-256 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 20N

The design concepts and measured performance characteristics are summarized of an X band (7162 MHz/8415 MHz) breadboard deep space transponder (DSP) for future spacecraft applications, with the first use scheduled for the Comet Rendezvous Asteroid Flyby (CRAF) and Cassini missions in 1995 and 1996, respectively. The DST consists of a double conversion, superheterodyne, automatic phase tracking receiver, and an X band (8415 MHz) exciter to drive redundant downlink power amplifiers. The receiver acquires and coherently phase tracks the modulated or unmodulated X band (7162 MHz) uplink carrier signal. The exciter phase modulates the X band (8415 MHz) downlink signal with composite telemetry and ranging signals. The receiver measured tracking threshold, automatic gain control, static phase error, and phase jitter characteristics of the breadboard DST are in good agreement with the expected performance. The measured results show a receiver tracking threshold of -158 dBm and a dynamic signal range of 88 dB. Author

N91-18329*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
FEASIBILITY STUDY OF A SYNTHESIS PROCEDURE FOR ARRAY FEEDS TO IMPROVE RADIATION PERFORMANCE OF LARGE DISTORTED REFLECTOR ANTENNAS Semiannual Status Report
W. L. Stutzman, K. Takamizawa, P. Werntz, J. LaPean, and R. Barts Feb. 1991 56 p
(Grant NAG1-859)
(NASA-CR-187954; NAS 1.26:187954) Avail: NTIS HC/MF A04 CSCL 20N

The following subject areas are covered: General Reflector Antenna Systems Program version 7(GRASP7); Multiple Reflector Analysis Program for Cylindrical Antennas (MRAPCA); Tri-Reflector 2D Synthesis Code (TRTDS); a geometrical optics and a physical optics synthesis techniques; beam scanning reflector, the type 2 and 6 reflectors, spherical reflector, and multiple reflector imaging systems; and radiometric array design. Y.S.

N91-18330# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
APPLICATION OF BACKPROPAGATION NEURAL NETWORKS TO PHONETIC ELEMENT CLASSIFICATION
Steven R. Bryan 1990 4 p Presented at the Seminar on Artificial Neural Networks, Pocatello, ID, 27 Apr. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006144; EGG-M-90454; CONF-9004273-1) Avail: NTIS HC/MF A01

A need was established in conjunction with an USAF-sponsored project to develop a speech element classifier. This classifier had to be capable of placing continuous speech into a number of phoneme-like categories, and also had to be independent of speaker identity and individual voice characteristics. The feasibility of using a neural network to perform this classification task was explored. The results of this exploration are discussed. DOE

N91-18331# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
STUDY ON PROPAGATION CHARACTERISTICS OF ELECTROMAGNETIC WAVE IN UNDERGROUND, PART 1
Y. Amano and K. Tanabe May 1990 23 p In JAPANESE; ENGLISH summary
(DE91-742146; CRIE-T-89065) Avail: NTIS HC/MF A03

Electromagnetic wave is used for underground survey, but underground is very non-uniform and attenuant. This paper proposed a new measuring method concerning the propagation characteristics of electromagnetic wave. This method used the balanced stripline (BS) which was composed of two wide outer conductors, shallow central conductor and supporting medium. Planar sample was inserted into BS to use as the transmitting medium for electromagnetic wave. The propagating time and attenuation of electromagnetic wave were measured. Propagating speed and attenuation constant were determined from measurements and dielectric constant and conductivity of the rock were calculated from the equation giving the propagation constant. This measuring method does not result the inferior contact between the conductors and sample and the error is small. The change of the width of the central conductor can reduce the mismatch reflection of characteristic impedance. This method was applied to rocks such as granite, andesite, tuff and sandstone in the frequency range of 13 to 500 MHz and the measurements were compared with measured values by impedance-analyzer to verify the effectiveness of this method. DOE

N91-18332*# University of Southern California, Los Angeles. Dept. of Electrical Engineering.
STUDY OF A CO-DESIGNED DECISION FEEDBACK EQUALIZER, DEINTERLEAVER, AND DECODER Final Report, 1 Jan. - 30 Sep. 1990
Robert E. Peile and Loyd Welch 1990 79 p
(Grant NAG3-982)
(NASA-CR-187961; NAS 1.26:187961) Avail: NTIS HC/MF A05 CSCL 17B

A technique that promises better quality data from band limited channels at lower received power in digital transmission systems is presented. Data transmission, in such systems often suffers from intersymbol interference (ISI) and noise. Two separate techniques, channel coding and equalization, have caused considerable advances in the state of communication systems and both concern themselves with removing the undesired effects of a communication channel. Equalizers mitigate the ISI whereas coding schemes are used to incorporate error-correction. In the past, most of the research in these two areas has been carried out separately. However, the individual techniques have strengths and weaknesses that are complementary in many applications: an integrated approach realizes gains in excess to that of a simple juxtaposition. Coding schemes have been successfully used in cascade with linear equalizers which in the absence of ISI provide excellent performance. However, when both ISI and the noise level are relatively high, nonlinear receivers like the decision feedback equalizer (DFE) perform better. The DFE has its drawbacks: it suffers from error propagation. The technique presented here takes advantage of interleaving to integrate the two approaches so that the error propagation in DFE can be reduced with the help of error correction provided by the decoder. The results of simulations carried out for both, binary, and non-binary, channels confirm that significant gain can be obtained by codesigning equalizer and decoder. Although, systems with time-invariant channels and simple DFE having linear filters were looked into, the technique is fairly general and can easily be modified for more sophisticated equalizers to obtain even larger gains. Author

N91-18333# European Space Agency, Paris (France).
FEASIBILITY OF IN-ORBIT TESTING OF INFLATABLE ANTENNAS WITH CELESTIAL SOURCES
J. W. M. Baars (Max-Planck-Inst. fuer Radioastronomie, Bonn, Germany, F.R.) and W. R. Burke, ed. Jun. 1990 66 p
(ESA-STM-243; ISSN-0379-4067; ETN-91-98621) Copyright Avail: NTIS HC/MF A04

The feasibility of measuring the main parameters of a 3 m class satellite borne inflatable antenna at 10 GHz by regarding the Sun or the Moon as a test transmitter is investigated. Provided the measurements are made during a relatively quiet period of solar activity, good data can be obtained for beam width, gain, and near sidelobe levels. The pointing accuracy of the antenna must be about 4 arc minutes over the scanning range of the order of 10 degrees. The receiver can be a simple transistor amplifier with a calibrated noise injection in the input line in order to measure the absolute antenna temperature. The main conclusions of the study are applicable to antennas whose diameter varies from 3 to 5 m. Appendices are given which describe: measurement of the absolute radio spectrum of the source and the use of the spectrum for calibration of larger antennas; the measurement of large antennas with cosmic radio sources; radio holographic reflector measurement of the 30 millimeter radio telescope at 22 GHz with a cosmic signal source; and phase retrieval radio holography in the Fresnel region. ESA

N91-18334 Politecnico di Milano (Italy). Dipt. di Elettronica.
FOCUSING SAR DATA WITH TIME-VARYING DOPPLER CENTROID
C. Prati and F. Rocca 1990 37 p Sponsored in part by Telespazio S.p.A.
(REPT-90-033; ETN-91-98645) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The problem of range or azimuth variations in Doppler centroid is analyzed. The defocusing effects caused by an incorrect Doppler centroid estimation are discussed. It is shown that efficiency frequency domain focusing techniques can be exploited, provided that SAR (Synthetic Aperture Radar) raw data is previously modified and a space varying nondimensional filter is applied to the focused image. The computational cost increased but was smaller than for space domain processing. Results obtained with simulated computer data and spot-light geometries are presented and show that Doppler centroid variations in azimuth due to platform instability, and rapid Doppler centroid variations with range due to Earth rotation, can be easily processed. ESA

N91-18335 Politecnico di Milano (Italy). Dipt. di Elettronica.
BLIND DECONVOLUTION FOR DOPPLER CENTROID ESTIMATION IN HIGH FREQUENCIES SAR
C. Prati, F. Rocca, Y. Kost, and E. Damonti 1990 28 p Sponsored in part by Telespazio S.p.A.
(REPT-90-034; ETN-91-98646) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The mathematical expression of the residual error that occurs when SAR (Synthetic Aperture Radar) data is focused with an incorrect alias of the PRF (Pulse Repetition Frequency) is derived. A blind deconvolution technique was used to estimate the actual PRF replica from the focused image. Squinted X band data were generated from the NASA AIR (Airborne Imaging Radar) airplane L and C bands data by means of an inversion of the focusing processes. Although the real data may show some differences with the simulated data, the proposed method represents a good alternative to conventional Doppler ambiguity estimation methods and appears to be more robust and simple than conventional techniques. ESA

N91-18336 Politecnico di Milano (Italy). Dipt. di Elettronica.
SEISMIC MIGRATION FOR SAR FOCUSING: INTERFEROMETRICAL APPLICATIONS
C. Prati (Consiglio Nazionale delle Ricerche, Milan, Italy), A. MontiGuarnieri, E. Damonti, and F. Rocca 1990 34 p Previously announced in IAA as A90-49676 Sponsored by Italian Space Agency, and ESA
(REPT-90-036; ETN-91-98648) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

SAR (Synthetic Aperture Radar) data focusing is analyzed from a theoretical point of view. Two applications of a SAR data processing algorithm are presented, where the phases of the returns are used for the recovery of interesting parameters of the observed scenes. Migration techniques, similar to those used in seismic signal processing for oil prospecting, were implemented for the determination of the terrain altitude map from a satellite and the evaluation of the sensor attitude for an airplane. A satisfying precision was achieved, since it was shown how an interferometric system is able to detect variations of the airplane roll angle of a small fraction of a degree. ESA

N91-18337# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SIGNALLING IN THE B-ISDN: A SURVEY OF THE STATE-OF-THE-ART
Geert Heijenk Jul. 1990 55 p
(MEMO-INF-90-35; ISSN-0923-1714; ETN-91-98659) Avail: NTIS HC/MF A04

Research issues concerning signaling, which arise from the evolution of the ISDN (Integrated Sevices Digital Network) towards a broadband ISDN (B-ISDN) are addressed. This evolution will be driven by the demand for new applications such as video conferencing, distribution of high definition television and bulk data transfer. The new requirements, put on the B-ISDN by these new applications are classified. Call topology, user mobility, traffic characteristics and service type (connectionless or connection oriented) are identified as classes of requirements. The concept of signaling, which refers to the exchange of information concerned with the control of calls, needs to be defined more precisely. Two separate parts can be identified in a signaling system, a transfer part concerned with the exchange of information, and a connection

control part concerned with the establishment, maintenance, and release of connections. In present telecommunication networks, usually different signaling systems are used for signaling between the user and the network and for signaling between the nodes in the network. The first type of signaling is called user network signaling. The second type of signaling is called intra network signaling. The user network signaling system of the ISDN is described. A survey of problems related to user network signaling in the B-ISDN is given. The intra network signaling system of the ISDN is described and problems concerning intra network signaling in the B-ISDN are surveyed. It is concluded that a lot of work on signaling is required in order to prepare for the introduction of the B-ISDN. ESA

N91-18338# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
TRANSMISSION OF COMPRESSED VIDEO
H. L. Pasch 10 Sep. 1990 42 p
(MEMO-INF-90-47; ISSN-0923-1714; ETN-91-98664) Avail: NTIS HC/MF A03

An overview of video coding is presented. The aim is not to give a technical summary of possible coding techniques, but to address subjects related to video compression in general and to the transmission of compressed video in more detail. Bit rate reduction is in general possible by removing redundant information; removing information the eye does not use anyway; and reducing the quality of the video. The codecs which are used for reducing the bit rate, can be divided into two groups: Constant Bit rate Codecs (CBC's), which keep the bit rate constant, but vary the video quality; and Variable Bit rate Codecs (VBC's), which keep the video quality constant by varying the bit rate. VBC's can be in general reach a higher video quality than CBC's using less bandwidth, but need a transmission system that allows the bandwidth of a connection to fluctuate in time. The current and the next generation of the PSTN does not allow this; ATM might. There are several factors which influence the quality of video: the bit error rate of the transmission channel, slip rate, packet loss rate/packet insertion rate, end-to-end delay, phase shift between voice and video, and bit rate. Based on the bit rate of the coded video, the following classification of coded video can be made: High Definition Television (HDTV); Broadcast Quality Television (BQTV); video conferencing; and video telephony. The properties of these classes are given. The video conferencing and video telephony equipment available now and in the next few years can be divided into three categories: conforming to 1984 CCITT standard for video conferencing; conforming to 1988 CCITT standard; and conforming to no standard. ESA

N91-18339 British Broadcasting Corp., Kingswood (England). Engineering Div.
DIGITAL SOUND: SUBJECTIVE TESTS ON LOW BIT-RATE CODECS
N. H. C. Gilchrist 1990 14 p
(BBC-RD-1990/16) Copyright Avail: Issuing Activity

At the beginning of 1990, BBC Research Department tested four experimental high-quality low bit-rate audio codecs which were under development as part of the Eureka 147 Digital Audio Broadcasting project. The work involved preliminary listening tests to identify critical test material, followed by formal subjective tests to determine audio quality and error performance. The listeners could detect some loss of audio quality with all of the codecs using the most critical material. There were also indications that one of the codecs did not always reproduce the phantom sound sources in their correct position. Author

N91-18340# Federal Aviation Administration, Atlantic City, NJ.
CONTROLLER EVALUATION OF INITIAL DATA LINK TERMINAL AIR TRAFFIC CONTROL SERVICES Final Report
Jan. 1991 68 p
(Contract T2001E)
(DOT/FAA/CT-90/29) Avail: NTIS HC/MF A04

The results of the first Federal Aviation Administration (FAA) Technical Center investigation of the initial terminal air traffic control services were evaluated in order to identify service delivery methods which optimize controller acceptance, performance, and workload. Author

N91-18341*# Ohio State Univ., Columbus. ElectroScience Lab.
CONSTITUTIVE PARAMETER DE-EMBEDDING USING INHOMOGENEOUSLY-FILLED RECTANGULAR WAVEGUIDES WITH LONGITUDINAL SECTION MODES Final Report
A. Park and A. K. Dominek Oct. 1990 132 p
(Grant NAG3-1000)
(NASA-CR-187990; NAS 1.26:187990; ESL-(72)1837-2) Avail: NTIS HC/MF A07 CSCL 20N

Constitutive parameter extraction from S parameter data using a rectangular waveguide whose cross section is partially filled with a material sample as opposed to being completely filled was examined. One reason for studying a partially filled geometry is to analyze the effect of air gaps between the sample and fixture for the extraction of constitutive parameters. Air gaps can occur in high temperature parameter measurements when the sample was prepared at room temperature. Single port and two port measurement approaches to parameter extraction are also discussed. Author

N91-18342# Technische Hochschule, Darmstadt (Germany, F.R.).
MEASURING DEVICE FOR CHECKING AND DEVELOPING RADIO CLOCK RECEIVERS Ph.D. Thesis [MESSPLATZ ZUM PRUEFEN UND ENTWICKELN VON FUNKUHREMPFAENGERN]
Ulrich Bellmann 1989 144 p In GERMAN
(ETN-91-98792) Avail: NTIS HC/MF A07

The measuring device is composed, on the one hand, of a signal generator with which a field strength can be produced within a determined zone, and on the other hand, of a measuring receiver with which the field can be measured. The advantage of the measuring device is that it shows that a specimen must not be operated in a radio shielded zone, but that a field strength exactly repeatable at each place can be tuned in by partial compensation or amplification of the external field. ESA

N91-18343# Lawrence Livermore National Lab., CA.
NUMERICAL MODELING OF HF SKYWAVE RADIATION FROM ANTENNAS IN IRREGULAR TERRAIN
G. J. Burke Nov. 1990 42 p
(Contract W-7405-eng-48)
(DE91-007115; UCRL-ID-105656) Avail: NTIS HC/MF A03

The problem of computing the radiation pattern of an HF antenna sited in irregular terrain was investigated. The primary interest is in antennas for skywave communication; however, ionospheric models were not considered. Several methods for modeling terrain effects are briefly reviewed. A geometrical optics model for arbitrary terrain is developed and results are compared with published results from solution of a Volterra integral equation for scattering by a Gaussian ridge. This report covers work on the first phase of a project for the U.S. Navy to develop and apply models for terrain effects in HF communications involving skywave. DOE

N91-18344# Oak Ridge National Lab., TN.
SIMPLIFIED HORN ANTENNA PARAMETER ESTIMATION USING SELECTIVE CRITERIA
P. D. Ewing 1991 15 p Presented at the 7th Annual Review of Progress in Applied Computational Electromagnetics, Monterey, 19-21 Mar. 1991
(Contract DE-AC05-84OR-21400)
(DE91-007195; CONF-9103123-1) Avail: NTIS HC/MF A03

An approximation can be used to avoid the complex mathematics and computation methods typically required for calculating the gain and radiation pattern of electromagnetic horn antenna. Because of the curvature of the antenna wave front, calculations using conventional techniques involve solving the Fresnel integrals and using computer-aided numerical integration. With this model, linear approximations give a reasonable estimate

of the gain and radiation pattern using simple trigonometric functions, thereby allowing a hand calculator to replace the computer. Applying selected criteria, the case of the E-plane horn antenna was used to evaluate this technique. Results showed that the gain approximation holds for an antenna flare angle of less than 10 degrees for typical antenna dimensions, and the E field radiation pattern approximation holds until the antenna's phase error approaches 60 degrees, both within typical design parameters. This technique is a useful engineering tool. DOE

N91-18345# Los Alamos National Lab., NM.
LOW-FREQUENCY COMPUTATIONAL ELECTROMAGNETICS FOR ANTENNA ANALYSIS
E. K. Miller and G. J. Burke (Lawrence Livermore National Lab., CA.) 1991 78 p Presented at the IEEE '91, Monterey, Mar. 1991
(Contract W-7405-eng-36)
(DE91-007384; LA-UR-91-109; CONF-9103124-1) Avail: NTIS HC/MF A05

An overview of low-frequency, computational methods for modeling the electromagnetic characteristics of antennas is presented here. The article presents a brief analytical background, and summarizes the essential ingredients of the method of moments for numerically solving low-frequency antenna problems. Some extensions to the basic models of perfectly conducting objects in free space are also summarized, followed by a consideration of some of the same computational issues that affect model accuracy, efficiency and utility. A variety of representative computations are then presented to illustrate various modeling aspects and capabilities that are currently available. A fairly extensive bibliography is included. DOE

N91-18346# California Univ., Berkeley. Lawrence Berkeley Lab.
COHERENT RADIATION IN AN UNDULATOR
Yong Ho Chin Dec. 1990 11 p Presented at the 4th ICFA Beam Dynamics Workshop, Tokyo, Japan, 22-29 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-007744; LBL-29981; CONF-9009292-4) Avail: NTIS HC/MF A03

This paper is concerned with the synchrotron radiation from an undulating electron beam in a rectangular waveguide. The analysis is based on the dyadic Green's function approach to solve Maxwell's equations in terms of the vector potential. It is shown analytically and numerically that the radiated energy spectrum may differ significantly from the free space results when the undulator length divided by the Lorentz factor of the electron beam is larger than the transverse size of the waveguide. Then, the appearance of the spectrum is changed into a small number of sharp peaks, each corresponding to an excited waveguide mode. The undulator radiation is identified with the wake field in beam instabilities. The concepts of wake function and impedance are introduced to formulate the present problem in the same manner as the beam instability problem, so that the accumulated techniques of the latter can be applied. It is shown that the obtained impedances satisfy the Panofsky-Wenzel theorem and other properties inevitable for wake fields. DOE

N91-18145*# Naval Postgraduate School, Monterey, CA.
HIGH-LATITUDE COMMUNICATIONS SATELLITE (HILACS)
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 153-163 Sponsored in part by JPL and NRL (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 17B

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N91-18347*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ABNORMAL FAULT-RECOVERY CHARACTERISTICS OF THE FAULT-TOLERANT MULTIPROCESSOR UNCOVERED USING A NEW FAULT-INJECTION METHODOLOGY
Peter A. Padilla Washington Mar. 1991 22 p
(NASA-TM-4218; L-16630; NAS 1.15:4218) Avail: NTIS HC/MF A03 CSCL 09C

An investigation was made in AIRLAB of the fault handling performance of the Fault Tolerant MultiProcessor (FTMP). Fault handling errors detected during fault injection experiments were characterized. In these fault injection experiments, the FTMP disabled a working unit instead of the faulted unit once in every 500 faults, on the average. System design weaknesses allow active faults to exercise a part of the fault management software that handles Byzantine or lying faults. Byzantine faults behave such that the faulted unit points to a working unit as the source of errors. The design's problems involve: (1) the design and interface between the simplex error detection hardware and the error processing software, (2) the functional capabilities of the FTMP system bus, and (3) the communication requirements of a multiprocessor architecture. These weak areas in the FTMP's design increase the probability that, for any hardware fault, a good line replacement unit (LRU) is mistakenly disabled by the fault management software. Author

N91-18348# Avco-Everett Research Lab., MA.
LIGHTWEIGHT TRANSFORMER Final Report, Sep. 1987 - May 1990
Daniel W. Swallom, ed., George Enos, ed., and Vladimir J. Hruby, ed. May 1990 84 p Prepared in cooperation with Busek (J.) Co., Inc., Needham, MA
(Contract DE-AC22-87PC-79676)
(DE91-004166; DOE/PC-79676/T2) Avail: NTIS HC/MF A05

The technical effort described in this report relates to the program that was performed to design, fabricate, and test a lightweight transformer for Strategic Defense Initiative Organization (SDIO) mission requirements. The objectives of this program were two-fold: (1) design and fabricate a lightweight transformer using liquid hydrogen as the coolant; and (2) test the completed transformer assembly with a low voltage, dc power source. Although the full power testing with liquid helium was not completed, the program demonstrated the viability of the design approach. The lightweight transformer was designed and fabricated, and low and moderate power testing was completed. The transformer is a liquid hydrogen cooled air core transformer that uses thin copper for its primary and secondary windings. The winding mass was approximately 12 kg, or 0.03 kg/kW. Further refinements of the design to a partial air core transformer could potentially reduce the winding mass to as low as 4 or 5 kg, or 0.0125 kg/kW. No attempt was made on this program to reduce the mass of the related structural components or cryogenic container. DOE

N91-18349# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
NICKEL/METAL HYDRIDE RECHARGEABLE BATTERY TECHNOLOGY ASSESSMENT: PROGNOSIS FOR LOAD-CONDITIONER USE
T. Ikeya Mar. 1990 51 p In JAPANESE; ENGLISH summary
(DE91-736748; CRIE-T-89031) Avail: NTIS HC/MF A04

Nickel/metal hydride battery was studied, for the load-conditioner use, to use hydrogen absorbing/storing alloy, which battery consists of nickel positive electrode and metal hydride negative electrode with stored quantity of hydrogen, more than

20 times as large as that of gaseous storage. Without consumption of electrolyte, due to charging or discharging, it is possible in maintenance freeing and enclosing. Also without change in shape, due to deposition of metallic dendrite on the negative electrode, it is long in life. With operation at ordinary temperature, the discharging curve has a wide flat portion, 1.2 to 1.3 V in width, to be assured of 80 percent in energy efficiency. Hydrogen in metal hydride is so quickly diffused as to enable the charging and discharging to be quick, and resist the over charging and discharging. In Japan and the USA, a battery of small capacity type has been developed, but one of large capacity has not been done yet. Presently for the load-conditioner use, the weight energy density is slightly low, but the volume energy density, cycle life, etc. are sufficiently satisfactory, with easiness in battery structuring, manufacturing and multi-cell composing, possibility of enlargement in capacity and mass production, and highness in safety. The enlargement in capacity must take into consideration thermo-chemical and powder technological characteristics of metal hydride. DOE

N91-18350# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
CONTROL SYSTEM AND OPERATION CHARACTERISTICS OF DC TRANSMISSION SYSTEMS BY SELF TURN-OFF TYPE INVERTER
I. Ishikawa May 1990 28 p In JAPANESE; ENGLISH summary
(DE91-736789; CRIE-T-89080) Avail: NTIS HC/MF A03

This paper described the operation characteristics of the dc transmission used with the self turn-off inverter connected to the weak ac system, and the controlling system. When reactive power is controlled by the phase control angle (beta), stable operation is possible up to 1.23 times short circuit ratio (SCR) for sudden change of dc power and up to 1.37 times for ac one circuit disconnection and voltage stability. DC voltage control by combining beta to conduction ratio (gamma), stable operation is possible for sudden change of dc power up to 0.95 times SCR even for ac one circuit disconnection. The voltage stability is improved. It was found that for the control of self turn-off inverter, the method of reactive power control by beta and dc voltage control by using beta and gamma were suitable. DOE

N91-18351# Materials Research Labs., Ascot Vale (Australia).
EFFECT OF SHRAPNEL PENETRATION ON LITHIUM-CARBON MONOFLUORIDE AND LITHIUM-MANGANESE DIOXIDE BATTERIES
W. N. C. Garrard 1990 13 p Original contains color illustrations
(MRL-TN-579; AR-006-331) Copyright Avail: NTIS HC/MF A03; 2 functional color pages

National BR2/3A lithium-carbon monofluoride and Duracell DL2/3A lithium-manganese dioxide batteries were subjected to simulated shrapnel penetration using a projectile from an M16 rifle. Trials were conducted on batteries in various states of charge (0, 50, and 100 percent discharged) in both wet and dry environments. Only one fully charged Duracell Battery (under wet conditions) caught fire during the test. The effects of environmental conditions, the chemical reactions involved, and the state of charge of the batteries on the probability of the batteries igniting are discussed. Author

N91-18352*# Auburn Univ., AL. Center for the Commercial Development of Space Power.
SILICON DEVICE PERFORMANCE MEASUREMENTS TO SUPPORT TEMPERATURE RANGE ENHANCEMENT
Semiannual Report, 7 May - 7 Nov. 1990
James Bromstead, Bennett Weir, R. Wayne Johnson, and Ray Askew 11 Feb. 1991 21 p
(Contract NCC3-175)
(NASA-CR-187904; NAS 1.26:187904) Avail: NTIS HC/MF A03 CSCL 09A

Semiconductor power devices are typically rated for operation below 150 C. Little data is known for power semiconductors over 150 C. In most cases, the device is derated to zero operating power at 175 C. At the high temperature end of the temperature range, the intrinsic carrier concentration increases to equal the doping concentration level and the silicon behaves as an intrinsic semiconductor. The increase in intrinsic carrier concentration results in a shift of the Fermi level toward mid-bandgap at elevated temperatures. This produces a shift in devices characteristics as a function of temperature. By increasing the doping concentration higher operating temperatures can be achieved. This technique was used to fabricate low power analog and digital devices in silicon with junction operating temperatures in excess of 300 C. Additional temperature effects include increased p-n junction leakage with increasing temperature, resulting in increased resistivity. The temperature dependency of physical properties results in variations in device characteristics. These must be quantified and understood in order to develop extended temperature range operation. Author

N91-18353# Lawrence Livermore National Lab., CA.
PHOTOCONDUCTIVE SWITCHING FOR HPM (HIGH POWER MICROWAVE) GENERATION
M. D. Pocha and W. W. Hofer 1990 12 p Presented at the 5th National Conference on High-Power Microwave Technology, West Point, NY, 10-15 Jun. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005398; UCRL-JC-102831; CONF-9006179-6) Avail: NTIS HC/MF A03

Photoconductive switching has been explored at LLNL and demonstrated to be a viable technology for high power microwave (HPM) generation. This technology enables the development of compact, portable, and efficient HPM sources. At LLNL we have successfully switched 35 KV in less than 200 ps using laser triggered, 1 x 5 x 20 mm GaAs switches. Based on these results we are developing an HPM generator with applications for HPM weapons and high power, wideband radar. The paper will discuss the physics limits and tradeoffs in the application of this technology. Among the topics discussed will be switching efficiency, candidate switch materials, laser requirements, applicable laser technologies, generator configurations, and cooling requirements and techniques. In addition to presenting theoretical and practical considerations, the paper will discuss on-going work at LLNL and elsewhere. DOE

N91-18354# Lawrence Livermore National Lab., CA.
INSULATOR BREAKDOWN MEASUREMENTS IN A POOR VACUUM AND THEIR INTERPRETATION
George E. Vogtlin Jun. 1990 6 p Presented at the International Symposium on Discharges and Electrical Insulation in Vacuum, Santa Fe, NM, 17-20 Sep. 1990
(Contract W-7405-eng-48)
(DE91-005431; UCRL-JC-103450; CONF-9009192-16) Avail: NTIS HC/MF A02

Breakdown measurements have been made on insulators with 0 and 45 degree angle surfaces. A technique of observing the electrons produced from the process has given some insight into the mechanisms involved. A three nanosecond pulse was used to induce breakdown. The electrons striking the anode were observed with a plastic fluor and open shutter camera. Two breakdown patterns were interpreted as cathode initiated and anode initiated breakdown. The breakdown process normally encountered was anode initiated with a positive 45 degree insulator. If the anode side was relieved with an internal electrode, the breakdown changed to cathode initiated at a higher level. If the cathode surface was then anodized, the breakdown switched back to the anode at an even higher level. Individual explosive emission sites on the cathode surface could be observed. Insulator breakdown was usually not associated with these sites. Multiple pulses allowed measurement of plasma expansion of the explosive emission sites. It is believed that breakdown with longer pulses is due to the expansion of the explosive emission site plasma to the insulator surface. Measurements were conducted with and without voltage conditioning. It appears that conditioning is achieved without explosive emission. It is believed that this is due to organic fibers

that are removed by the conditioning. Organic fibers were used to induce both anode and cathode breakdown. Measurements of fiberous material have shown explosive emission a low as 100 kV on a three nanosecond time scale and below 20 kV/cm on a longer time scale. DOE

N91-18355# Lawrence Livermore National Lab., CA.
PHOTOCONDUCTIVE SWITCHING FOR HIGH POWER MICROWAVE GENERATION
M. D. Pocha and W. W. Hofer Oct. 1990 10 p Presented at the OPTCON '90: SPIE Symposium on Laser Science and Applications of Optics, Boston, MA, 4-9 Nov. 1990
(Contract W-7405-eng-48)
(DE91-005433; UCRL-JC-104841; CONF-9011125-4) Avail: NTIS HC/MF A02

Photoconductive switching is a technology that is being increasingly applied to generation of high power microwaves. Two primary semiconductors used for these devices are silicon and gallium arsenide. Diamond is a promising future candidate material. This paper discusses the important material parameters and switching modes, critical issues for microwave generation, and future directions for this high power, photoconductive switching technology. DOE

N91-18356# Argonne National Lab., IL. Energy Systems Div.
USER'S GUIDE TO DIANE VERSION 2.1: A MICROCOMPUTER SOFTWARE PACKAGE FOR MODELING BATTERY PERFORMANCE IN ELECTRIC VEHICLE APPLICATIONS
W. W. Marr, W. J. Walsh, and P. C. Symons (Electrochemical Engineering Consultants, Inc., Morgan Hill, CA.) Jun. 1990 59 p
(Contract W-31-109-eng-38)
(DE91-006071; ANL/ESD-8) Avail: NTIS HC/MF A04

DIANE is an interactive microcomputer software package for the analysis of battery performance in electric vehicle (EV) applications. The principal objective of this software package is to enable the prediction of EV performance on the basis of laboratory test data for batteries. The model provides a second-by-second simulation of battery voltage and current for any specified velocity time or power time profile. The capability of the battery is modeled by an algorithm that relates the battery voltage to the withdrawn current, taking into account the effect of battery depth-of-discharge (DOD). Because of the lack of test data and other constraints, the current version of DIANE deals only with vehicles using fresh batteries with or without regenerative braking. Deterioration of battery capability due to aging can presently be simulated with user input parameters accounting for an increase of effective internal resistance and/or a decrease of cell no-load voltage. DIANE 2.1 is written in FORTRAN language for use on IBM-compatible microcomputers. DOE

N91-18357# Sandia National Labs., Albuquerque, NM. Capacitors Div.
THERMAL AND ELECTROSTRICTIVE EXPANSION CHARACTERISTICS OF MLC (MULTILAYER CERAMIC) CAPACITORS
R. Chanchani and C. A. Hall 1991 7 p Presented at the 11th Capacitor and Resistor Technology Symposium, Las Vegas, NV, 4-7 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-005962; SAND-90-2361C; CONF-9103102-3) Avail: NTIS HC/MF A02

We have measured by strain gauge technique, in-plane thermal expansivity (coefficient of thermal expansion) as a function of temperature and electrostrictive expansion as a function of applied DC voltage for ceramic capacitors with X7R, NPO and N1500 dielectrics. Multilayer Ceramic (MLC) capacitor materials from two commercial suppliers were evaluated. Thermal expansivities of these materials were compared to polyimide-quartz boards and alumina ceramic substrates. DOE

N91-18358# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
APPLICATION OF THE GSFUDS TO ADVANCED BATTERIES AND VEHICLES
A. F. Burke and G. H. Cole 1990 11 p Presented at the 10th International Electric Vehicle Symposium: Electrical Vehicle: A Viable Technology, Hong Kong, 3-5 Dec. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006116; EGG-M-90443; CONF-901207-1) Avail: NTIS HC/MF A03

The GSFUDS approach to determining appropriate battery test power profiles is applied to various combinations of advanced batteries and electric vehicles. Computer simulations are used to show that the SFUDS velocity driving profile developed for the IDSEP electric vehicle also yielded energy consumption (Wh/km) and peak power values for other vehicles of greatly different characteristics that are in good agreement with the corresponding values for the same vehicles on the FUDS driving cycle. The computer results also showed that the GSFUDS power steps expressed as multiples of the average power, Pav are applicable to electric vehicles in general for the SFUDS driving profile if the peak power step is altered to reflect the changes in the vehicle design. A general procedure is given for presenting battery test data in terms of the constant power and GSFUDS Ragone curves from which the vehicle range can be determined for the FUDS and other driving cycles for different vehicle designs. DOE

N91-18359# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
EVALUATION OF PULSE POWER DEVICES IN ELECTRIC VEHICLE PROPULSION SYSTEMS
A. F. Burke and E. J. Dowgiallo (Department of Energy, Washington, DC.) 1990 23 p Presented at the 10th International Electric Vehicle Symposium: Electric Vehicle Technology, Hong Kong, 3-5 Dec. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006117; EGG-M-90473; CONF-901207-2) Avail: NTIS HC/MF A03

The application of pulse power devices in electric vehicle propulsion systems to load level the main energy storage battery has been studied. Both high energy density capacitors (ultracapacitors) and high power density, bipolar batteries are considered. Computer simulations of vehicle operation with hybrid (two power source) powertrains indicated the energy storage capacities of the pulse power devices required to load level the main battery are 300 to 500 Wh for the capacitors and 5 to 10 Ah for the bipolar batteries can be reduced from 79 W/kg to about 40 W/kg depending on the vehicle gradeability (speed, percent grade, and length of grade) desired. Evaluation of the status of the technology for the pulse power devices indicated that for both devices, improvements in technology are needed before the devices can be used in EV applications. In the case of the uitracapacitor, the energy density of present devices are 1 to 2 Wh/kg. A minimum energy density of about 5 Wh/kg is needed for electric vehicle applications. Progress in increasing the energy density of ultracapacitors has been rapid in recent years and the prospects for meeting the 5 Wh/kg requirement for EVs appear to be good. For bipolar batteries, a minimum power density of 500 W/kg is needed and the internal resistance must be reduced by about a factor of ten from that found in present designs. DOE

N91-18360# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
SIMULATION OF ELECTRIC VEHICLES WITH HYBRID POWER SYSTEMS
A. F. Burke and G. H. Cole 1990 16 p Presented at the 10th International Electric Vehicle Symposium: Electric Vehicle: A Viable Technology, Hong Kong, 3-5 Dec. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006118; EGG-M-90445; CONF-901207-3) Avail: NTIS HC/MF A03

Computer programs for the simulation of the operation of

electric vehicles with hybrid power systems are described. These programs treat cases in which high energy density ultracapacitors or high power density pulse batteries are used to load level the main energy storage battery in the vehicle. A generalized control strategy for splitting the power between the main battery and the pulse power devices is implemented such that the user can specify the nominal battery power as a function of the state-of-charge of the ultracapacitor or pulse power battery. The programs display graphically on the screen, as they run, the power from both the main battery and the pulse power device and the state-of-charge of the pulse power device. After each run is completed, a summary is printed out from which the effect of load leveling the battery on vehicle range and energy consumption can be determined. Default input files are provided with the programs so various combinations of vehicles, driveline components, and batteries of special current interest to the EV community can be run with either type of pulse power device. Typical simulation results are shown including cases in which the pulse power devices are connected in parallel with the main battery without interface electronics. DOE

N91-18361# Fermi National Accelerator Lab., Batavia, IL.
A SIMPLIFIED, IMPROVED METHOD FOR MAKING AMPLIFIER EQUIVALENT NOISE CHARGE MEASUREMENTS USING A NEW GENERATION DIGITIZING OSCILLOSCOPE
Tom Zimmerman Oct. 1990 9 p
(Contract DE-AC02-76CH-03000)
(DE91-006821; FNAL-TM-1699) Avail: NTIS HC/MF A02

Historically a variety of methods have been used to measure the equivalent noise charge (ENC) of amplifier/shaper systems for high energy physics. Some of these methods require several pieces of special test equipment and a fair amount of effort. The advent of digitizing oscilloscopes with statistics capabilities makes it possible to perform certain types of noise measurements accurately with very little effort. This paper describes the noise measurement method of a time invariant amplifier/shaper and of a time variant correlated sampling system, using a Tektronix DSA602 Digitizing Signal Analyzer. DOE

N91-18362# Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD.
ELECTRIC VEHICLES
Mar. 1990 10 p Sponsored by DOE
(DE91-004821; DOE/CE-0289P) Avail: NTIS HC/MF A02

Quiet, clean, and efficient, electric vehicles (EVs) may someday become a practical mode of transportation for the general public. Electric vehicles can provide many advantages for the nation's environment and energy supply because they run on electricity, which can be produced from many sources of energy such as coal, natural gas, uranium, and hydropower. These vehicles offer fuel versatility to the transportation sector, which depends almost solely on oil for its energy needs. Electric vehicles are any mode of transportation operated by a motor that receives electricity from a battery or fuel cell. EVs come in all shapes and sizes and may be used for different tasks. Some EVs are small and simple, such as golf carts and electric wheel chairs. Others are larger and more complex, such as automobile and vans. Some EVs, such as fork lifts, are used in industries. In this fact sheet, we will discuss mostly automobiles and vans. There are also variations on electric vehicles, such as hybrid vehicles and solar-powered vehicles. Hybrid vehicles use electricity as their primary source of energy, however, they also use a backup source of energy, such as gasoline, methanol or ethanol. Solar-powered vehicles are electric vehicles that use photovoltaic cells (cells that convert solar energy to electricity) rather than utility-supplied electricity to recharge the batteries. These concepts are discussed. DOE

N91-18363# Washington State Energy Office, Olympia.
HIGH EFFICIENCY MOTOR SELECTION HANDBOOK
Gilbert A. McCoy, Todd Litman, and John G. Douglass Oct. 1990 59 p
(Contract DE-FC79-82BP-34623)
(DE91-006231; DOE/BP-34623/2) Avail: NTIS HC/MF A04

Substantial reductions in energy and operational costs can be achieved through the use of energy-efficient electric motors. A handbook was compiled to help industry identify opportunities for cost-effective application of these motors. It covers the economic and operational factors to be considered when motor purchase decisions are being made. Its audience includes plant managers, plant engineers, and others interested in energy management or preventative maintenance programs. DOE

N91-18364# Sandia National Labs., Albuquerque, NM.
A METHOD FOR ENCAPSULATING HIGH VOLTAGE POWER TRANSFORMERS
Robert O. Sanchez 1990 6 p Presented at the 11th Capacitor and Resistor Technology Symposium, Las Vegas, NV, 4-7 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-006644; SAND-90-2435C; CONF-9103102-2) Avail: NTIS HC/MF A02

Voltage breakdowns become a major concern in reducing the size of high-voltage power converter transformers. Even the smallest of voids can provide a path for corona discharge which can cause a dielectric breakdown leading to a transformer failure. A method of encapsulating small high voltage transformers has been developed. The method virtually eliminates voids in the impregnation material, provides an exceptional dielectric between windings and provides a mechanically rugged package. The encapsulation material is a carboxyl terminated butadiene nitril (CTBN) modified mica filled epoxy. The method requires heat/vacuum to impregnate the coil and heat/pressure to cure the encapsulant. The transformer package utilizes a diallyl phthalate (DAP) contact assembly in which a coated core/coil assembly is mounted and soldered. This assembly is then loaded into an RTV mold and the encapsulation process begins. DOE

N91-18365# Argonne National Lab., IL. Electrochemical Technology Program.
LITHIUM BATTERIES FOR PULSE POWER
Laszlo Redey 1990 12 p Presented at the 178th Meeting of the Electrochemical Society, Seattle, WA, 14-19 Oct. 1990
(Contract W-31-109-eng-38)
(DE91-006663; CONF-901073-11) Avail: NTIS HC/MF A03

New designs of lithium batteries having bipolar construction and thin cell components possess the very low impedance that is necessary to deliver high-intensity current pulses. The research and development and understanding of the fundamental properties of these pulse batteries have reached an advanced level. Ranges of 50 to 300 kW/kg specific power and 80 to 130 Wh/kg specific energy have been demonstrated with experimental high-temperature lithium alloy/transition-metal disulfide rechargeable bipolar batteries in repeated 1- to 100-ms long pulses. Other versions are designed for repetitive power bursts that may last up to 20 or 30 s and yet may attain high specific power (1 to 10 kW/kg). Primary high-temperature Li-alloy/FeS2 pulse batteries (thermal batteries) are already commercially available. Other high-temperature lithium systems may use chlorine or metal-oxide positive electrodes. Also under development are low-temperature pulse batteries: a 50-kW Li/SOCl2 primary batter and an all solid-state, polymer-electrolyte secondary battery. Such pulse batteries could find use in commercial and military applications in the near future. DOE

N91-18366# Allied-Signal Aerospace Co., Kansas City, MO.
MOISTURE ABSORPTION AND BAKEOUT CHARACTERISTICS OF RIGID-FLEXIBLE MULTILAYER PRINTED WIRING BOARDS
J. W. Lula Jan. 1991 17 p
(Contract DE-AC04-76DP-00613)
(DE91-006825; KCP-613-4408) Avail: NTIS HC/MF A03

Moisture absorption and bakeout characteristics of rigid flexible printed wiring boards were determined. It was found that test specimens had absorbed 0.95 weight percent moisture when equilibrated to a 50 percent RH, 25 C environment. Heating those equilibrated specimens in a 120 C static air oven removed 92 percent of this absorbed moisture in 24 h. Heating the samples in

a 80 C static air oven removed only 64 percent of the absorbed moisture at the end of 24 h. A 120 C vacuum bake removed moisture at essentially the same rate with parylene slowed the absorption rate by approximately 50 percent but did not appreciably affect the equilibrium moisture content or the drying rate. DOE

N91-18367# Sandia National Labs., Albuquerque, NM.
ADVANCED LEAD-ACID BATTERIES FOR UTILITY APPLICATIONS
Abbas Akhil and Al Landgrebe (Department of Energy, Washington, DC.) 1991 9 p Presented at the 3rd International Conference on Batteries for Utility Energy Storage, Kobe, Japan, 18-22 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-007070; SAND-91-0175C; CONF-910350-1) Avail: NTIS HC/MF A02

During 1990, Sandia National Laboratories initiated an advanced lead acid battery development program. The goal is to develop a low maintenance, cost effective battery by the mid- to late 1990's that is tailored to a variety of electric utility applications. Several parallel activities are being pursued to achieve this goal. One activity seeks to quantify the economic benefits of battery storage for specific cases in candidate utility systems and identify opportunities for field demonstration of battery systems at electric utility and utility customer sites. Such demonstrations will not only generate valuable operating experience data, but will also help in building user confidence in battery storage systems. Other activities concentrate on cell- and battery-level research and development aimed at overcoming shortcomings in existing technologies, such as Valve Regulated Lead Acid (VRLA), or, sealed lead acid batteries. DOE

N91-18368# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
OPERATION TEST OF A LOAD CONDITIONER USING SEALED LEAD-ACID BATTERIES AND LIFE CYCLE TEST OF LEAD-ACID BATTERIES
T. Yokota, T. Iwahori, and K. Kumai May 1990 32 p In JAPANESE; ENGLISH summary
(DE91-742131; CRIE-T-89058) Avail: NTIS HC/MF A03

This report explains test results of load conditioner operation, using sealed lead-acid batteries, and number-of-cycles characteristics of sealed lead-acid batteries and accelerated life cycle tests on lead-acid batteries. Used batteries were 18 NP-38Ah units, laminated one on another, 216V in battery voltage and 8.2kWh battery capacity, and integrated with a power converter. The load was mainly assumed to be that for the air conditioning use. The batteries were shortened to about 400 cycles in life, if sealed not to require the water supply, but could be lengthened to about 700 cycles, if provided with an appropriate system of charging. The load conditioner was designed to be compact and have maintenance-free operation. In the load conditioner operation with sealed lead-acid batteries, the daily quantitative ratio of charging to discharging largely influences the life cycle. An accelerated life cycle test was proposed and proved to be appropriate. DOE

N91-18369# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
CHARGE DISCHARGE CHARACTERISTIC OF LI/MoS2 MULTICELL INCLUDING AN OVERCHARGED CELL AND AN OVERDISCHARGED CELL
K. Ishihara, K. Kumai, T. Ikeya, T. Iwahori, and T. Tanaka Aug. 1990 35 p In JAPANESE; ENGLISH summary
(DE91-742132; CRIE-T-89055) Avail: NTIS HC/MF A03

In order to evaluate the influence of unbalance in cell voltage on the life of a large number of secondary lithium cells, laminated one on another, a test method, called Floating Method, was designed to be able to evaluate the behavior of single cell, in a series string of multi-stage connection by a small number of cells. For the Floating Method, taking it into consideration that, in a multi-stage series connection, even 100 in number of stages, the voltage of one cell, even if unbalanced, can be almost neglected in influence, as dispersed on the other cells, and assuming one cell, charging and discharging in fundamental, to be a group of cells, connected into a multi-stage series, each cell was simulated in a series string of multi-stage connection by cells, connected into series and under a floating condition. When the lithium/molybdenum disulfide batteries were evaluated in charging and discharging behavior by that method, the operation was known to be comparatively stable, with exception of a small instability under the charging condition, which stability is characterized to be advantageous for the connection into a multi-stage series. DOE

N91-18370# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
RESEARCH AND DEVELOPMENT OF LITHIUM/POLYACENIC SEMICONDUCTOR (PAS) BATTERY FOR LOAD CONDITIONER USE
K. Ishihara, T. Iwahori, T. Tanaka, S. Yata, H. Kinoshita, and T. Komori Aug. 1990 49 p In JAPANESE; ENGLISH summary
(DE91-742134; CRIE-T-89046) Avail: NTIS HC/MF A03

In order to develop a lithium secondary battery for load conditioner use, the basic performance of a polyacenic semiconductor (PAS) cathode for a lithium secondary battery was examined. Following results are obtained; specific capacity of 130Ah/kg, specific energy of 375Wh/kg based on the PAS weight, and high energy efficiency of 93 percent, under the normal cutoff voltage range of 4V/2V. An outlook for achievement of a development aim (gravimetric energy density of 70Wh/kg, volumetric energy density of 120Wh/l, and power performance of 20Wh/kg or above) for a load conditioner battery, is shown. In addition, a cycle test of floating cells including overcharged and overdischarged cells connected in series, shows that a lithium/PAS cell has the advantage of having a substantial buffer capacity above and below the normal cutoff voltages and would be stable over a large number of cells connected in series. DOE

N91-18371# Technische Univ., Berlin (Germany, F.R.). Fachbereich Electrotechnik.
VOLTAGE INTERMEDIATE CIRCUIT INVERTER FOR NETWORK SUPPLY OF REGENERATIVE ENERGY Ph.D. Thesis [SPANNUNGSWISCHENKREIS-UMRICHTER ZUR NETZEINSPEISUNG REGENERATIVER ENERGIE]
Manfred Nahrstaedt 1990 113 p In GERMAN
(ETN-91-98779) Avail: NTIS HC/MF A06

A power electric circuit which allows the supply of electric energy from a synchronous generator driven by a wind wheel under optimum conditions to the public three phase system is examined. Different inverter circuits are examined for their suitability. The control and the regulation of the inverter are described. The results show that an active power regulation operation is possible with a simple digital regulation through a microprocessor, and with vanishing fundamental harmonic oscillation power and minimum network distortion. ESA

N91-18372# National Aeronautical Lab., Bangalore (India). Materials Science Div.
MEASUREMENT UNDER PRESSURE OF THERMOELECTRIC POWER ALONG THE THICKNESS OF A THIN SPECIMEN
Sheela K. Ramasesha and Anil K. Singh Sep. 1990 11 p
(NAL-PD-MT-9012) Avail: NTIS HC/MF A03

A method of measuring, under pressure, the thermoelectric power along the thickness of thin specimens is described. This method is useful in measuring thermoelectric power in a direction perpendicular to the cleavage plane of a crystal. Author

N91-18373# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
A PROCESS FOR POWER MEASUREMENT OF INVERTERS WITH OSCILLATING COMPONENTS OF HIGH FREQUENCY IN CURRENT AND VOLTAGE Ph.D. Thesis [EIN VERFAHREN ZUR LEISTUNGSMESSUNG AN STROMRICHTERN MIT WECHSELANTEILEN HOHER FREQUENZ IN STROM UND

SPANNUNG]
Hans-Kilian Spielbauer 1990 120 p In GERMAN
(ETN-91-98781) Avail: NTIS HC/MF A06

A measuring process for the accurate effective power measurement of power electronic equipment is described. Power definitions and processes were examined for the effective power measurement. Time domain realization was to be preferred to a computational intensive representation in frequency field. A measuring system prototype was built. An integrated measuring process was chosen. The hardware and software components are described in detail. It is shown that the signal processor is adapted for a quick frequency determination. An error analysis is carried out by means of reference sources. An increase in the bandwidth of the signal amplifier could notably raise the measuring accuracy. ESA

N91-18374# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
DEVELOPMENT AND EXAMINATION OF MICRO GTOS Ph.D. Thesis [ENWICKLUNG UND UNTERSUCHUNG VON MIKRO-GDTOS]
Ning Qu 1990 190 p In GERMAN
(ETN-91-98782) Avail: NTIS HC/MF A09

A new component called micro gate turn off (GTO) was developed, in order to improve the breaking capacity of (GTO) thyristors. The basic consideration, the masking project, the fabrication technology, the static and dynamic measurements, the theoretical investigation of the transmission characteristics, and the dynamic breaking processes of this new component were considered. ESA

N91-18375# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
EXAMINATION OF POWER TRANSISTORS IN HIGH WORKING FREQUENCY OSCILLATOR CONVERTERS Ph.D. Thesis [UNTERSUCHUNG VON LEISTUNGSTRANSISTOREN IN SCWINGKREISWECHSELRICHTER HOHER ARBEITSFREQUENZ]
Dirk Tegtmeier 1990 114 p In GERMAN
(ETN-91-98785) Avail: NTIS HC/MF A06

Power transistors are examined for application in high working frequency oscillator converters. Basic control processes are described, with the example of oscillator converter series. Quasi ring switches and their properties are presented. A zero current switch and a zero voltage switch circuit are considered, with the example of a direct current regulating unit. The most suitable transistors are short operating time transistors, such as field effect transistors and static induction transistors. ESA

N91-18376# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
INFORMATION ACQUISITION FOR KNOWLEDGE BASED FAULT DIAGNOSIS OF ELECTRONIC CIRCUITS Ph.D. Thesis [INFORMATIONSAKQUISITION FUER DIE WISSENSBASIERTE FEHLERDIAGNOSE ELEKTRONISCHER SCHALTUNGEN]
Reza VaezGhaemi 1990 114 p In GERMAN
(ETN-91-98786) Avail: NTIS HC/MF A06

The high cost of information acquisition is the essential obstacle to the spreading of knowledge based systems for solving diagnosis problems. The determination of the diagnosis strategy is the main point. The possibilities and limits of the utilization of inductive learning algorithms are examined. The fault diagnosis of analog circuits requires the consideration of tolerance effects for components. A knowledge base advisory system is designed to perform diagnosis measuring tasks for information acquisition. ESA

N91-18377# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
INFLUENCE OF RADIATION INDUCED ELECTRONS ON THE STRUCTURAL TRANSMISSION FOR THE FABRICATION OF INTEGRATED CIRCUITS BY MEANS OF X RAY LITHOGRAPHY Ph.D. Thesis [EINFLUSS VON STRAHLUNGSINDUZIERTEN ELEKTRONEN AUF DIE STRUKTURUEBERTRAGUNG ZUR HERSTELLUNG INTEGRIERTER SCHALTUNGEN MITTELS ROENTGENSTRAHLLITHOGRAPHIE]
Juergen Chlebek 1990 130 p In GERMAN
(ETN-91-98794) Avail: NTIS HC/MF A07

X ray lithography is described as a process for structural transmission. The influence of electrons on structures produced by x ray lithography is determined experimentally. A simulation of energy deposition by radiation induced electrons is carried out. A Monte Carlo simulation is developed, in order to simulate x ray lighting. The simulation is tested by means of data in the fields of microdosimetry and microanalysis, on the local energy deposition and the transmission and reflection behaviors of electrons. ESA

N91-18378# Department of Energy, Washington, DC. Office of Classification and Technology Policy.
RADIOLUMINESCENT LIGHTING TECHNOLOGY
1990 129 p Presented at the Technology Transfer Conference: Radioluminescent Lighting Technology, Annapolis, 25-26 Sep. 1990
(DE91-004918; CONF-9009201) Avail: NTIS HC/MF A07

The glow-in-the-dark stereotype that characterizes the popular image of nuclear materials is not accidental. When the French scientist, Henri Becquerel, first discovered radioactivity in 1896, he was interested in luminescence. Radioluminescence, the production of light from a mixture of energetic and passive materials, is probably the oldest practical application of the unstable nucleus. Tritium based radioluminescent lighting, in spite of the biologically favorable character of the gaseous tritium isotope, was included in the general tightening of environmental and safety regulations. Tritium light manufacturers would have to meet two fundamental conditions: (1) The benefit clearly outweighed the risk, to the extent that even the perceived risk of a skeptical public would be overcome; and (2) The need was significant enough that the customer/user would be willing and able to afford the cost of regulation that was imposed both in the manufacture, use, and eventual disposal of nuclear materials. In 1981, researchers at Oak Ridge National Laboratory were investigating larger radioluminescent applications using byproduct nuclear material such as krypton-85, as well as tritium. By 1982, it appeared that large source, (100 Curies or more) tritium gas tube, lights might be useful for marking runways and drop zones for military operations and perhaps even special civilian aviation applications. The successful development of this idea depended on making the light bright enough and demonstrating that large gas tube sources could be used and maintained safely in the environment. The basic program goals were achieved. This is a detailed report of what they have learned, proven, and discovered. DOE

N91-18379# Pacific Northwest Lab., Richland, WA.
ADVANCED MATERIALS AND ELECTROCHEMICAL PROCESSES IN HIGH-TEMPERATURE SOLID ELECTROLYTES
J. L. Bates, L. A. Chick, G. E. Youngblood, and W. J. Weber Oct. 1990 22 p
(Contracts DE-AC06-76RL-01830; DE-AC05-84OR-21400)
(DE91-005181; PNL-SA-18864) Avail: NTIS HC/MF A03

Fuel cells for the direct conversion of fossil fuels to electric energy necessitates the use of high temperature solid electrodes. This study has included: (1) determination of electrical transport, thermal and electrical properties to illucidate the effects of microstructure, phase equilibria, oxygen partial pressure, additives, synthesis and fabrication on these properties; (2) investigation of synthesis and fabrication of advanced oxide materials, such as La(0.9)Sn(0.1)MnO3; and (3) application of new analytical techniques using complex impedance coupled with conventional

electrochemical methods to study the electrochemical processes and behavior of materials for solid oxide fuel cells and other high temperature electrolyte electrochemical process. DOE

N91-18380# Stanford Linear Accelerator Center, CA.
DESIGN OF A HIGH POWER CROSS FIELD AMPLIFIER AT X BAND WITH AN INTERNALLY COUPLED WAVEGUIDE
K. Eppley and Kwok Ko Jan. 1991 11 p Presented at the 4th OE/LASE '91 Society of Photo-Optical Instrumentation Engineers (SPIE) International Symposium, Los Angeles, 20-25 Jan. 1991
(Contract DE-AC03-76SF-00515)
(DE91-007591; SU-SLAC-PUB-5416; CONF-910123-4) Avail: NTIS HC/MF A03

Cross field amplifiers (CFA) have been used in many applications where high power, high frequency microwaves are needed. Although these tubes have been manufactured for decades, theoretical analysis of their properties is not as highly developed as for other microwave devices such as klystrons. We have developed a simulation model for CFAs using the PIC code CONDOR. Our simulations indicate that there are limits to the maximum RF field strength that a CEA can sustain. When the fields become too high, efficiency becomes very poor, and the currents drawn may become so large that secondary emission cannot be maintained. It is therefore desirable to reduce the circuit impedance of a very high power tube. One method for doing this, proposed by Feinstein, involves periodically coupling a standard CFA circuit to an internal waveguide. Most of the power flows in the waveguide, so the overall impedance is much reduced. By adjusting the guide dimensions one can vary the impedance. Thus one can retain high impedance at the low power end but low impedance at the high power end. In principle one can maintain constant RF voltage throughout the tube. CONDOR simulations have identified a good operating point at X band, with power generation of over 5 MW per cm and total efficiency of over 60 percent. ARGUS simulations have modelled the cold test properties of the coupled structure. The nominal design specifications are 300 MW output, 17 db gain, frequency 11.4 GHz, dc voltage 142 kV, magnetic field 5 kG, anode cathode gap 3.6 mm, total interaction length about 60 cm. We will discuss the results of code simulations and report on the status of the experimental effort. DOE

N91-18298*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA DEVELOPMENTS IN SOLID STATE POWER AMPLIFIERS
Regis F. Leonard *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 3-10 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 09A

N91-18987*# Auburn Univ., AL. Dept. of Electrical Engineering.
CURRENT LIMITING REMOTE POWER CONTROL MODULE
Douglas C. Hopkins *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09A

N91-18998*# Tennessee Univ., Chattanooga. Dept. of Mechanical Engineering-Mechanics.
THERMAL ANALYSIS SIMULATION FOR A SPIN-MOTOR USED IN THE ADVANCED MAIN COMBUSTION CHAMBER VACUUM PLASMA SPRAY PROJECT USING THE SINDA COMPUTER PROGRAM
Gary H. McDonald *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09A

N91-19011*# Alabama Univ., Huntsville. Dept. of Computer Science.
DEVELOPMENT OF NICKEL HYDROGEN BATTERY EXPERT SYSTEM
Sajjan G. Shiva *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 10C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N91-18381*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN UPWIND-BIASED SPACE MARCHING ALGORITHM FOR SUPERSONIC VISCOUS FLOW
Francis A. Greene Washington Mar. 1991 44 p
(NASA-TP-3068; L-16788; NAS 1.60:3068) Avail: NTIS HC/MF A03 CSCL 20D

The modifications are documented which were made to the Langley Aerothermodynamic Upwind Relaxation Algorithm which allow it to compute solutions in a space marching manner. The space marching flux is formulated to be either first- or second-order accurate, using Roe's upwind differencing or Symmetric Total Variation Diminishing differencing, respectively. The algorithm solves the thin layer Navier-Stokes equations, and is subject to the same flow restrictions as a parabolized Navier-Stokes solver. Each cross flow plane is locally iterated in time until converged, then marched in space to the next station. The algorithm is tested on a sphere-cone geometry and a geometry which models the windward side of the Space Shuttle Orbiter. Computational results for surface heating are compared to ground based experimental data. In addition, space marching predictions for surface pressure are compared against values from the original algorithm. Author

N91-18382# Washington Univ., Seattle. Dept. of Applied Mathematics.
AN ALTERNATIVE APPROACH TO DISTURBANCES IN BOUNDARY LAYERS
P. F. Easthope and W. O. Criminale (Advanced System Architectures Ltd., Alton, England) 1990 22 p
(Contract DE-FG06-88ER-25061; AF-AFOSR-0404-89)
(DE91-005594; DOE/ER-25061/8) Avail: NTIS HC/MF A03

By modelling the boundary layer on a flat plate as a piece-wise linear velocity profile it is possible to analyze disturbances in the flow in a systematic manner. The approach is that of an initial value, boundary value problem but, unlike classical normal modes employed in stability theory, the solutions here can be obtained in closed form and they are non separable. A specific example is treated where the vertical component of the perturbation velocity is prescribed as a localized pulse initially. The amplitude is then depicted as a function of time and the coordinates of the plane of the flat plate at a fixed vertical location. The role of three dimensionality and the initial transient period of development (heretofore unknown) are both shown to be of significant importance in the dynamics. An argument is given to strongly suggest that the origin of large scale oscillations known to be prevalent in turbulent shear flows may well be explained using these bases. DOE

N91-18383 North Carolina State Univ., Raleigh.
THE APPLICATION OF THE BOUNDARY ELEMENT METHOD TO PREDICT THE RESPONSE OF A DIFFERENTIAL OPERATOR MODEL FOR A COUPLED

VISCOELASTIC-ACOUSTIC SYSTEM Ph.D. Thesis
Kassem Moustafa Mourad 1990 201 p
Avail: Univ. Microfilms Order No. DA9033522

The objective is the development of a numerical solution procedure based on the boundary element method (BEM) to study the steady state and transient response of a 3-D coupled arbitrarily shaped viscoelastic structure acoustic cavity system. The theory incorporates the direct BEM using constant triangular boundary elements. In addition to the usual boundary conditions of traction and displacements for the viscoelastic structure, and pressure and normal derivative of pressure for the acoustic cavity, impedance boundary conditions are also formulated and implemented. The model components, the viscoelastic structure and the acoustic cavity, can be used independently for the purpose of studying the individual component dynamics for varying boundary and excitation inputs. A derivation of a BEM formulation in the Laplace domain is established for the wave propagation in the viscoelastic media, characterized by the differential operator constitutive equation. A BEM formulation for the acoustic cavity is derived also in the Laplace transform domain. Then, both formulations are coupled together to establish a 3-D model in the Laplace transform domain that describes the behavior of both the fluid cavity and the viscoelastic structure in contact with it taking into account the fluid-structure coupling effects. The numerical implementation of the BEM formulation is developed into a computer code.
Dissert. Abstr.

N91-18384 Pennsylvania State Univ., University Park.
A NUMERICAL SCHEME FOR TIME-ACCURATE SOLUTIONS OF INCOMPRESSIBLE FLOW EQUATIONS Ph.D. Thesis
Mahesh Madhukar Athavale 1990 203 p
Avail: Univ. Microfilms Order No. DA9032239

A numerical scheme to compute time-accurate solutions of incompressible flow problems is developed. Flow equations in primitive variables and in fully coupled form are used. The divergence-free velocity condition is achieved by using a dual time-stepping approach. The flow equations, cast in a pseudotime, tau, are integrated in tau until convergence for each physical time step. Three-dimensional time-accurate solutions of the flow through a marine propeller operating in a wake-dominated flow-field were obtained. Convective flux derivatives are evaluated using third-order accurate upwind-biased flux-split differencing. The implicit operators generated using upwind fluxes are diagonally dominant and have good stability and convergence characteristics. In multidimensional problems, inversion of the operators is done by using an implicit lower-upper (L-U) factorization. Stability of the overall integration procedure is carefully analyzed using a Fourier transform method in vector form. The pseudotime-integration procedure is found to be unconditionally stable in all spatial dimensions, and for all pseudo-time steps. Boundary conditions for inviscid flow problems are enforced using the method of characteristics (MOC) in implicit form. A variety of one- and two-dimensional flow problems are computed. Fast convergence rates are obtained in one- and two-dimesional problems: typically 4 to 11 iterations per physical time step are found sufficient. In three-dimensional flows, the accuracy is verified by comparing the finite difference solutions with velocity potential and other numerical solutions. Time-dependent flow through a marine propeller operating in a wake-influenced flow field is computed as an engineering application. For these calculations 4 to 7 iterations are required per time step. Dissert. Abstr.

N91-18385 Catholic Univ. of America, Washington, DC.
PHYSICAL AND COMPUTATIONAL INVESTIGATION OF THE WALL PRESSURE FLUCTUATIONS IN A CHANNEL FLOW Ph.D. Thesis
Michael Paul Horne 1990 172 p
Avail: Univ. Microfilms Order No. DA9027628

Wall pressure fluctuations within an equilibrium rectangular channel flow geometry were studied. The objective was to obtain experimentally the statistical properties of the wall pressure fluctuations for a generic turbulent flow within a rectangular channel and to directly compare the results with those obtained from a full solution to the Navier-Stokes equations via Direct Numerical Simulation (DNS). An extensive data base was obtained from the physical experiment. Profiles for the mean and fluctuation components of the streamwise velocity were obtained at a number of spanwise locations and served to establish the existence of equilibrium flow conditions over a range of Reynolds numbers. Two issues of fundamental importance were studied. First, the results from both experiments were compared directly. Secondly, the spectral results for rectangular channel flow were compared directly to results obtained from typical outer flow regimes as represented by flat plate boundary layers. Although similarity scaling was shown to exit, the turbulence structure was shown to decay approximately twice as fast as obtained in external flows. No universal law was found to exist which brings both internal and external flow regimes into coincidence. An extensive high quality data base was obtained for generic channel flow at low Reynolds numbers which may be use to assess the quality of typical DNS experimental results. Dissert. Abstr.

N91-18386 Illinois Inst. of Tech., Chicago.
EXPERIMENTAL AND NUMERICAL ANALYSIS OF THE NOVEL TRAPPED-VORTEX PAIR AND COANDA TYPE FLUIDIC OSCILLATORS FOR FLOW RATE MEASUREMENT Ph.D. Thesis
Hussein A. Mansy 1990 264 p
Avail: Univ. Microfilms Order No. DA9032908

A concept in fluidic oscillators was discovered as a result of systematic experimentation. The fundamental physical mechanisms of instability were identified and simulated with the use of line vortex method. A parametric study of the effects of changes in geometry on the performance of a class of conventional Coanda-type fluidic oscillators was conducted. The Coanda-type meter was characterized by a high loss of flow energy compared to more conventional flow meters. In particular, the central wedge component and a fluid feedback loop were found to be the main sources of energy loss. To circumvent these problems, a completely new concept in fluidic oscillators was discovered and named the trapped-vortex pair (TVP) oscillator. The operation of the new oscillator relies on the generation of a counter-rotating vortex pair confined to a convergent channel section in the device. The vortices oscillate due to a hydrodynamic instability resulting from the inviscid interaction between the vortex pair. A numerical model was developed to assist in prediction of the characteristics of the trapped vortex pair fluidic oscillator. The inviscid motion of a pair of counter-rotating line vortices in an isosceles triangular domain with angles of 60 and 90 degrees was studied for a variety of initial conditions. Spectral analysis showed that the motion of vortices was characterized by two modes of oscillation, a symmetric and an anti-symmetric mode. Many trends observed in the experiment were predicted using this model, such as, the linearity of the flow rate-frequency calibration, increase in frequency with decreasing area of the fluidic oscillator, and the elliptical trajectories of the vortices during their cycle of oscillation. Dissert. Abstr.

N91-18387# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
RAYLEIGH-TAYLOR INSTABILITY IN COMPRESSIBLE FLUIDS Final Technical Report, 1 Oct. 1989 - 30 Sep. 1990
B. Sturtevant 5 Nov. 1990 13 p Prepared for Lawrence Livermore National Lab., CA
(Contracts W-7405-eng-48; CIT-79-61805)
(DE91-005221; UCRL-CR-105617) Avail: NTIS HC/MF A03

This is a report of the progress during the past year of the shock-tube study of the Richtmyer-Meshkov instability, initiated under the sponsorship of the Lawrence Livermore National Laboratory in September, 1982. The purpose of this research program, as stated in the original proposal, is to investigate the nonlinear processes initiated by shock wave interaction with gas-gas interfaces. In particular, the nonlinear stage of shock-initiated Rayleigh-Taylor instability, the secondary instabilities (e.g., Kelvin-Helmholtz instability) arising therefrom and the concomitant mixing of the two fluids are of interest. DOE

N91-18388# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
PROCEEDINGS OF THE TOUGH WORKSHOP
Karsten Pruess, ed. Sep. 1990 165 p Workshop held in Berkeley, CA, 13-14 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-005405; LBL-29710; CONF-9009228) Avail: NTIS HC/MF A08

A workshop on applications and enhancements of the TOUGH/MULKOM family of multiphase fluid and heat flow simulation programs was held at Lawrence Berkeley Laboratory on September 13 to 14, 1990. The workshop was attended by 62 scientists from seven countries with interests in geothermal reservoir engineering, nuclear waste isolation, unsaturated zone hydrology, environmental problems, and laboratory and field experimentation. The meeting featured 21 technical presentations, extended abstracts of which are reproduced in the present volume in unedited form. Simulator applications included processes on a broad range of space scales, from centimeters to kilometers, with transient times from seconds to geologic time scales. A number of code enhancements were reported that increased execution speeds for large 3-D problems by factors of order 20, reduced memory requirements, and improved user-friendliness. The workshop closed with an open discussion session that focussed on future needs and means for interaction in the TOUGH user community. Input from participants was gathered by means of a questionnaire that is reproduced in the appendix. DOE

N91-18389# Lawrence Livermore National Lab., CA.
AN OPTICAL TECHNIQUE FOR THE DIRECT MEASUREMENT OF THE 2-D SPECTRAL DENSITY OF A PASSIVE SCALAR IN A TURBULENT FLOW
H. F. Robey, G. F. Albrecht, and T. R. Moore Apr. 1990 23 p Presented at the 21st AIAA Fluid Dynamics, Plasma Dynamics and Lasers Conference in Conjunction with the AIAA 25th Thermophysics and Heat Transfer Conference and the 16th Aerodynamic Ground Testing Conference, Seattle, WA, 18-20 Jun. 1990 Previously announced in IAA as A90-38791
(Contract W-7405-eng-48)
(DE91-005423; UCRL-JC-103552; CONF-9006153-4) Avail: NTIS HC/MF A03

A new optical technique for quantitatively measuring the spectral density of passive scalar fluctuations in a turbulent flow has been developed. The technique exploits the photorefractive properties of BaTiO3 to separate the optical signal of the turbulent field from the coherent illumination background. It is a major improvement over existing techniques in that it is non-intrusive, has excellent frequency response and spatial resolution, and is capable of simultaneously measuring two components of the three-dimensional spectral density. The technique is thus especially well suited to the direct study of anisotropic flows. We have applied this technique to study the spectrum of temperature fluctuations in a fully developed turbulent channel flow with heat addition. The flow is highly anisotropic, yet the spectrum in directions transverse to the flow is seen to exhibit an inertial-convective subrange behavior which is characteristic of isotropic flows. The spectral behavior in the flow direction, due to the direct influence of the mean strain rate, is observed to be markedly different. DOE

N91-18390*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SECOND-ORDER CLOSURE MODELS FOR SUPERSONIC TURBULENT FLOWS Final Report
Charles G. Speziale and Sutanu Sarkar Jan. 1991 25 p Presented at the AIAA 29th Aerospace Sciences Meeting
(Contract NAS1-18605)
(NASA-CR-187508; NAS 1.26:187508; ICASE-91-9) Avail: NTIS HC/MF A03 CSCL 20D

Recent work on the development of a second-order closure model for high-speed compressible flows is reviewed. This turbulent closure is based on the solution of modeled transport equations for the Favre-averaged Reynolds stress tensor and the solenoidal part of the turbulent dissipation rate. A new model for the compressible dissipation is used along with traditional gradient transport models for the Reynolds heat flux and mass flux terms. Consistent with simple asymptotic analyses, the deviatoric part of the remaining higher-order correlations in the Reynolds stress transport equations are modeled by a variable density extension of the newest incompressible models. The resulting second-order closure model is tested in a variety of compressible turbulent flows which include the decay of isotropic turbulence, homogeneous shear flow, the supersonic mixing layer, and the supersonic flat-plate turbulent boundary layer. Comparisons between the model predictions and the results of physical and numerical experiments are quite encouraging. Author

N91-18391# Department of Energy, Washington, DC. Office of Industrial Programs.
ADVANCED HEAT EXCHANGERS PROGRAM REVIEW MEETING Summary Report
Jul. 1990 282 p Meeting held in Herndon, VA, 11-12 Oct. 1989
(DE91-004625; CONF-8910245-SUMM) Avail: NTIS HC/MF A13

On a semiannual basis a review meeting of the U.S. Department of Energy's Advanced Heat Exchangers Program is held with the objective of reviewing ongoing and recently completed project activities. During the meeting, personnel from industrial contractors and national laboratories who have been funded to develop advanced heat exchanger technology by the U.S. Department of Energy, Office of Industrial Programs present technical aspects of their projects. The projects generally deal with mid to high temperature waste heat recuperation and other subject areas of heat exchange. Each presentation is followed by a discussion period during which the presenters field questions from the meeting attendees. This report documents the most recent meeting, held October 11 to 12, 1989. It is composed primarily of a series of short sections addressing the individual projects. Each section includes presentation slides of the project and a summary of questions and answers that followed. An appendix of meeting attendees is also included. Individual projects have been processed separately for the data bases. DOE

N91-18392# Argonne National Lab., IL. Reactor Engineering Div.
TESTING OF A SODIUM HEAT PIPE
Robert E. Holtz 1991 7 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-9 Jan. 1991
(Contract W-31-109-eng-38)
(DE91-005834; CONF-910116-13) Avail: NTIS HC/MF A02

The operation of a heat pipe with both thermal radiation and convection heat rejection has been experimentally examined. The thermal radiation heat rejection conditions are similar to those which would be experienced in a space environment. The experimental results show good agreement with the analytical model. DOE

N91-18393# Idaho National Engineering Lab., Idaho Falls.
R5FORCE/MOD3s: A PROGRAM TO COMPUTE FLUID INDUCED FORCES USING HYDRODYNAMIC OUTPUT FROM THE RELAP5/MOD3 CODE
J. C. Watkins Sep. 1990 105 p
(Contract DE-AC07-76ID-01570)
(DE91-006209; EGG-EAST-9232) Avail: NTIS HC/MF A06

This report describes an update of a computer program which operates on hydrodynamic output from the RELAPS/MOD3 program and computes piping hydrodynamic force/time histories for input into various structural analysis codes. This version of the program is compatible with RELAPS/MOD3 and the Micro Vax computing environment whereas an earlier version of the program was compatible with RELAPS/MOD1. The report describes the force calculation theory, showing the development of a general force equation and the solution of this equation within the RELAPS output structure. To illustrate the calculational method and provide

results for discussion, a sample problem is presented. A detailed user manual for the computer program is included as an appendix. DOE

N91-18394# Lawrence Livermore National Lab., CA.
EXAMINATION OF COHERENCY CRITERIA FOR HIGH VELOCITY JETS
Michael J. Murphy 24 Aug. 1990 11 p Presented at the 12th International Symposium on Ballistics, San Antonio, TX, 30 Oct. - 1 Nov. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006242; UCRL-102943; CONF-9010190-3) Avail: NTIS HC/MF A03

An examination of a coherency criteria for high velocity jets is discussed in this paper. An analysis of the classical Pugh, Eichelberger, Rostoker jetting theory is used to develop an equation that defines the maximum coherent jet velocity as a function of the liner material sound speed, the liner beta angle, and the magnitude and direction of the liner collapse velocity vector. The liner material sound speed is assumed to be the liner material shock velocity at the time of liner material collapse. This shock velocity is a function of the collapse pressure in the stagnation region and thus varies with time and position along the liner. The analysis indicates that coherent jets at velocities greater than three times the liner shock velocity are possible with some combinations of the beta and collapse vector angles while incoherent jets at velocities equal to two times the liner shock velocity could occur with other combinations. The objectives of this paper are to examine the theory used to calculate jet velocity and to develop a criteria for calculating the maximum coherent jet tip velocity. DOE

N91-18395# California Univ., Berkeley. Dept. of Mechanical Engineering.
THE TURBULENT TRANSPORT OF HEAT WITHIN A LONGITUDINAL VORTEX/BOUNDARY LAYER INTERACTION
Pamela A. Eibeck May 1989 10 p
(Contract DE-FG03-87ER-13780)
(DE91-006865; DOE/ER-13780/T2) Avail: NTIS HC/MF A02

The turbulent transport of heat in boundary layer flows which contain coherent longitudinal swirl is examined. These flows often occur in energy conversion devices and can lead to localized augmentation of heat transfer. The underlying objective is to develop a simple model that engineers can use to predict local convection in these 3-D flows. Very little is known about the turbulent transport of heat in such complex flow environments. Most widespread models, such as the mixing length and the k-epsilon models, assume a turbulent transport proportional to the local gradient. This does not produce reasonable predictions of the flows containing counter gradients. Additionally, most heat transfer model assume the turbulent transport of heat is analogous with the momentum transfer. In 3-D flows, it is unlikely that scalars will respond to the flow field in the same way that momentum will. For example, turbulent convection, induced by the large swirling motions, may transport scalar quantities to a greater extent than the momentum. The research consists of an experimental and a modeling effort. The goal of the experimental program is to measure the turbulent heat flux in three different flow configurations: a boundary layer containing a single longitudinal vortex; a boundary layer containing a horseshoe vortex; and the flow over a row of obstacles that generate an array of streamwise vortices. DOE

N91-18396# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
QUALITATIVE, MATHEMATICAL ANALYSIS OF THE RICHARDS' EQUATION
B. H. Gilding Oct. 1990 29 p
(MATHS-MEMO-894; ISSN-0169-2690; ETN-91-98691) Avail: NTIS HC/MF A03

The Richards' equation is widely used as a model for the flow of water in unsatured soils. For modeling one dimensional flow in a homogeneous soil this equation can be cast in the form of a specific nonlinear partial differential equation with a time derivative and one spatial derivative. A survey of recent progress in the pure mathematical analysis of the last equation is carried out and the interpretation of the results of the analysis is emphasized. The results are explained in terms of the qualitative behavior of the flow of water in an unsaturated soil which is described by the Richards' equation. ESA

N91-18397*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
APPLICATION OF A NEW K-TAU MODEL TO NEAR WALL TURBULENT FLOWS Final Report
S. Thangam, R. Abid, and Charles G. Speziale Feb. 1991 12 p Previously announced in IAA as A91-19383 Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187518; ICASE-91-16; NAS 1.26:187518) Avail: NTIS HC/MF A03 CSCL 20D

A recently developed K-tau model for near wall turbulent flows is applied to two severe test cases. The turbulent flows considered include the incompressible flat plate boundary layer with the adverse pressure gradients and incompressible flow past a backward facing step. Calculations are performed for this two-equation model using an anisotropic as well as isotropic eddy-viscosity. The model predictions are shown to compare quite favorably with experimental data. Author

N91-18398# National Aeronautical Lab., Bangalore (India). Propulsion Div.
PREDICTION OF FLOW WITHIN SUPERCRITICAL COMPRESSOR CASCADE USING A TIME MARCHING METHOD
H. Girigoswami Sep. 1990 10 p
(NAL-PD-PR-9013) Avail: NTIS HC/MF A02

A semi-explicit time marching method is used to solve two dimensional Euler equations for a supercritical cascade which was designed by Garabedian and Korn, using complex characteristics. It is a time dependent damping surface method which gives a second order time accurate steady state solution. An H-type grid with finite volume formulation is adopted here. For a set of H-type grids, the computed surface Mach number distributions are compared with the design values. Smooth grids are observed to produce reasonable accurate solutions. Author

N91-18399# National Aeronautical Lab., Bangalore (India). Experimental Aerodynamics Div.
EXPERIMENTS ON THE TURBULENT BOUNDARY LAYER ON A FLAT PLATE IN THE WAKE OF ANOTHER FLAT PLATE
S. Sundaram and K. S. Yajnik Jan. 1990 39 p
(NAL-TM-EA-9001) Avail: NTIS HC/MF A03

Experiments were conducted on the development of the turbulent boundary layer on a flat plate which was located in the wake of another flat plate. The investigation covered six cases in which the distance between the plates and the momentum thickness of the upstream wake were varied. The results show that the mean velocity and longitudinal fluctuation in the outer layer can be represented by a slowly varying perturbation of the usual similarity solutions. The perturbation intensity falls by a factor of 2 over a distance of 30 to 90 times the momentum thickness. The results also suggest that the large scale motions that have arisen in the wake and the motions generated subsequently in the wall layer are not well correlated. Author

N91-18400# Los Alamos National Lab., NM.
IDENTIFICATION AND DETERMINATION OF SOLITARY WAVE STRUCTURES IN NONLINEAR WAVE PROPAGATION
W. I. Newman, D. K. Campbell, and J. M. Hyman 1991 11 p Presented at the 1st International Conference on Mathematical and Numerical Aspects of Wave Propagation Phenomena, Strasbourg, France, 23-26 Apr. 1991
(Contract W-7405-eng-36)
(DE91-004866; LA-UR-90-4068; CONF-910416-1) Avail: NTIS HC/MF A03

Nonlinear wave phenomena are characterized by the appearance of solitary wave coherent structures traveling at speeds

determined by their amplitudes and morphologies. Assuming that these structures are briefly noninteracting, a method is proposed for the identification of the number of independent features and their respective speeds. Using data generated from an exact two-soliton solution to the Korteweg-deVries equation, the method is tested and its strengths and limitations are discussed. DOE

N91-18401# Catholic Univ. of America, Washington, DC.
OPTICAL INSTRUMENTATION AND STUDY OF GAS-SOLID SUSPENSION FLOWS
S. C. Ling and H. P. Pao Sep. 1990 39 p
(Contract DE-FG22-86PC-90956)
(DE91-005533; DOE/PC-90956/T10) Avail: NTIS HC/MF A03

A new technique and particle detecting system for the quantification of local fluid flow velocities, particle concentrations and size distributions in gas-solid suspension flows has been successfully developed and constructed. A new 2-inch diameter pneumatic-pipe test-loop facility for study of solids transport flows has been built and is in operation. In order to check scaling law developed from the experimental results in the 2-inch pipe, a 4-inch pipe test-loop facility was also designed and constructed. In the past, the mechanics of suspended-solid flow have not been solved in a closed form due to the lack of a model for the turbulent field to pick up solid particles from the flow boundary. In this research project, we have identified the existence of micro-hairpin vortices as a major mechanism for the lifting of solid particles from the flow boundary. This permits one to formulate a realistic model. That is, the introduction of a particle source term in the governing transport equation for the suspended particles. The resultant solution predicts the correct critical flow conditions for the initial pickup of different sizes of solid particles and their subsequent concentrations in the flow field. DOE

N91-18402# Indiana Univ., Bloomington.
THE ASYMPTOTIC DEGREES OF FREEDOM OF FLUID FLOWS
C. Foias Sep. 1990 9 p
(Contract DE-FG02-86ER-25020)
(DE91-007548; DOE/ER-25020/2) Avail: NTIS HC/MF A02

We have obtained rigorous estimates for the attractors of some basic dissipative differential equations which are within the physical or numerical ranges (e.g., 2D Navier-Stokes equations). We have shown that the ring laser cavity equations have a finite dimensional attractor. We have constructed inertial manifolds for a large class of dissipative differential equations (e.g., Kuramoto-Sivashinsky and Ginzberg-Landau equations). For a large class of equations including the 2D Navier-Stokes equations we have introduced several approximate inertial manifolds which yield new approximative ordinary differential equations with better error estimates then those of the usual Galerkin approximations. We have evidence that the new approximating schemes lead to computational improvements upon the Galerkin schemes. We have given a normal form for the Navier-Stokes which allows the explicit asymptotic integration of the equations. We have also proposed a new theoretical approach to decaying homogeneous turbulence. We also made some contribution to robust control theory which may be relevant to fluid dynamics. DOE

N91-18403# Lawrence Livermore National Lab., CA.
SPH (SMOOTHED PARTICLE HYDRODYNAMICS) SIMULATIONS OF HYPERVELOCITY IMPACTS
L. D. Cloutman 24 Jan. 1991 18 p
(Contract W-7405-eng-48)
(DE91-007625; UCRL-ID-105520) Avail: NTIS HC/MF A03

The smoothed particle hydrodynamics (SPH) method has been used to simulate several cases of hypervelocity impact in an exploratory study to determine the suitability of the method for such problems. The calculations compare favorably with experimental results and with other numerical simulations. We discuss the requirements that must be satisfied for SPH to produce accurate simulations of such problems. DOE

N91-18025# Wichita State Univ., KS. Dept. of Aerospace Engineering.
COMPUTATIONAL FLUID DYNAMICS IN AEROSPACE ENGINEERING AT WICHITA STATE UNIVERSITY Abstract Only
Steve Klausmeyer, S. Reddy, X. Lui, and M. Papadakis *In its* Proceedings: Techfest 17 1991 p 24 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18027# Wichita State Univ., KS. Dept. of Mechanical Engineering.
LDV MEASUREMENTS OF A JET IN A CROSSFLOW Abstract Only
Julie A. Mathis *In its* Proceedings: Techfest 17 1991 p 26 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18982*# Mississippi State Univ., Mississippi State. Dept. of Aerospace Engineering.
MULTI-BLOCKING STRATEGIES FOR THE INS3D INCOMPRESSIBLE NAVIER-STOKES CODE
Boyd Gatlin *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N91-18404# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
DESIGN ANALYSIS OF A NOVEL LOW TEMPERATURE BOLOMETER
M. Nahum and P. L. Richards Sep. 1990 5 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990 Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE91-005291; LBL-28992; CONF-900944-25) Avail: NTIS HC/MF A01

We propose a novel antenna-coupled superconducting bolometer which makes use of the thermal boundary resistance available at low temperatures. The radiation is collected by a planar self-complementary antenna and thermalized in a small thin film resistor. The resulting temperature rise is detected by a transition edge thermometer which can be (but need not be) a separate film. All components are deposited directly on a substrate so that arrays can be conveniently produced by conventional lithographic techniques. The active area of the bolometer is thermally decoupled by its small size and by the thermal resistance of the boundaries with the substrate and the antenna terminals. Design calculations based on a 2 times 2 (mu)m square film of a superconductor with Tc approx. 0.1 K give an NEP approx. 10(exp -18) WHz(exp -1/2), time constant approx. 10(exp -6) s and responsivities up to approx. 10(exp 9) V/W. These specifications meet the requirements for NASA's Space Infrared Telescope Facility and Sub-Millimeter Moderate Mission. Useful applications also exist at He-3 and He-4 temperatures. The calculated NEP scales as T(exp 5/2). Materials, architectures, and readout schemes will be discussed. DOE

N91-18405# Oak Ridge National Lab., TN. Applied Technology Div.
DYNAMIC HIGH-TEMPERATURE-PHOSPHOR THERMOMETRY
K. W. Tobin, G. J. Capps, J. D. Muhs, D. Barton Smith, and M. R.

Cates Aug. 1990 19 p
(Contract DE-AC05-84OR-21400)
(DE91-005632; ORNL/ATD-43) Avail: NTIS HC/MF A03

Dynamic surface phosphor thermometry is being investigated as part of a continuing effort by the Applied Technology Division (ATD) at Oak Ridge National Laboratory (ORNL) to develop and apply thermographic phosphor technology to an ever expanding thermometry field. The purpose of this program is to develop dynamic surface phosphor thermometry to a stage where funding proposals can be strengthened by establishing a strong information base and demonstrating a sound capability. As a new technology development in an area well established by ATD/ORNL, dynamic thermometry is extremely important for high-temperature materials, superconducting materials, advanced turbomachinery, space vehicles, industrial process equipment, and other development areas. This laboratory project illustrated the technique of continuously monitoring dynamic temperature excursions using phosphor thermography. Temperature-increase rates on the order of 100 or more degrees centigrade per millisecond were measured, which illustrated a temporal response of greater than 0.001 s. This exceeded by a factor of ten the goal or the project and gave strong encouragement for further development of the technology. Important to the project, too, was the establishment of a clear analytical base for fluorescent-ratio data. Using the results of this study, specific solutions to dynamic-temperature-measurement problems in many application areas can be developed. In addition, the dynamic-thermographic technology can be coupled with strain measurement, two-dimensional analysis, and thermometry at very high temperatures to add interrelating remote measurement tools for systems that currently cannot be effectively studied. DOE

N91-18406*# Thiokol Corp., Brigham City, UT. Space Operations.
ENVIRONMENTAL DATA RECORDER (EDR) QUALIFICATION Final Report
Richard A. Danforth 15 Jan. 1991 112 p
(Contract NAS8-30490)
(NASA-CR-184108; NAS 1.26:184108; TWR-60248; PUBL-910960) Avail: NTIS HC/MF A06 CSCL 14B

Qualification testing of the environmental data recorder (EDR) was successfully completed. The purpose of this test was to qualify the EDR so that it could monitor segments shipped via railcar from Utah to Kennedy Space Center (KSC). The tests consisted of a transportation and a functional test. The transportation test verified EDR operation in its intended environment. The functional test verified EDR accuracy. Data from the functional test showed that the EDR accuracies complied with requirements. Since the EDR meets or exceeds all of its test objectives, it was successfully qualified. It is recommended that the EDR replace the transportation monitoring unit (TMU). A description of the qualification procedure is presented. Author

N91-18407# Bertin et Cie., Aix-les-Milles (France). Optics and Optoelectronics Div.
FIBER OPTIC MAGNETIC FIELD SENSOR USING SPECTRAL MODULATION ENCODING
M. Lequime, C. Meunier, and H. Giovannini (Ecole Nationale Superieure de Physique, Marseilles, France) 1990 7 p Presented at 8th Fiber Optics Sensors Conference, San Jose, CA, Sep. 1990
(ETN-91-98619) Avail: NTIS HC/MF A02

A fiber optic magnetic field sensor based on spectral modulation encoding techniques is described. This device uses a Faraday magneto-optic element as a tranducer and converts the rotation of the plane of polarization of the light induced by the magnetic field into a small change in the large optical path difference provided by a birefringent coding plate. The use of a broadband source and of an interferometric detector, with an optical path difference matched to the sensor one, enables high resolution and perfect down lead insensitivity. A dual wavelength arrangement is proposed to determine the temperature and magnetic field values with the same probe. The first experiments performed with a SF57 glass rod demonstrated the efficiency of such an arrangement and confirmed the theoretical sensitivity evaluations. The use of substituted iron garnets as sensing element should allow it to reach better thermal properties for the whole probe and to avoid any kind of temperature corrections in a large thermal range (100 C). ESA

N91-18408 British Broadcasting Corp., Kingswood (England). Engineering Div.
REAL-TIME MOTION MEASUREMENT HARDWARE: PHASE CORRELATION UNIT
S. C. Dabner 1991 19 p
(BBC-RD-1990/11) Copyright Avail: Issuing Activity

One of the most important techniques with the highest potential for increasing the quality and scope of future television systems and equipment is motion compensation. Motion compensation relies on the accurate determination of the velocities of objects in the image plane so that any movement can be accounted for in subsequent image processing operations. Experimental equipment designed and built at BBC Research Department for undertaking such velocity measurement is described; it forms one part of a complete real-time video motion estimation system and is based on the phase correlation method of motion vector extraction. The equipment described implements the phase correlation itself. The design of the equipment is discussed and some results obtained from it are presented. Author

N91-18409# Ceramphysics, Inc., Westerville, OH.
A MINIATURE INEXPENSIVE, OXYGEN SENSING ELEMENT
R. W. Arenz 31 Dec. 1990 8 p
(Contract DE-FG01-88CE-15401)
(DE91-007212; DOE/CE-15401/T10) Avail: NTIS HC/MF A02

Current progress on the development of the oxygen sensor is reviewed. During this quarter the sensor seal and heating element was redesigned and prototypes were tested. A combustor experiment will be performed in the next one to two quarters. Related information on lean sensors is also reviewed. Additional testing was done on multilayer sensors pulled from storage. DOE

N91-18410# Los Alamos National Lab., NM.
BATTLEFIELD LASER WAVEMETER
C. Reiser and C. C. Jensen 1990 5 p Presented at the International Conference on Lasers '90, San Diego, 10-14 Dec. 1990
(Contract W-7405-eng-36)
(DE91-007485; LA-UR-91-362; CONF-901263-6) Avail: NTIS HC/MF A01

In this paper we present a summary of the specifications and architecture for a ruggedized laser wavemeter. This wavemeter is about the size of a pocket calculator and has a wavelength resolution of one part per million. The detectable wavelength range is from the near infrared to the near ultraviolet. The wavemeter is specifically designed to distinguish laser threats from incoherent light sources and measure multiple wavelengths simultaneously. The information update rate is greater than ten readings per second. DOE

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N91-18411# Lawrence Livermore National Lab., CA.
PHYSICS STUDY OF THE APPLICATION OF AN IFEL (INDUCTION-ACCELERATOR FREE-ELECTRON LASER) TO CIT
E. B. Hooper, ed., B. I. Cohen, R. H. Cohen, Y. Matsuda, T. D. Rognlein, and G. R. Smith 15 Oct. 1990 39 p
(Contract W-7405-eng-48)
(DE91-004993; UCRL-ID-104103-REV-1) Avail: NTIS HC/MF A03

The induction accelerator free electron laser (IFEL) presents

an important option for generating high power millimeter waves for electron cyclotron heating and current drive in CIT. Application of the technology to this purpose requires resolution of a number of technical and physics issues. An effort was undertaken this year to resolve several of the CIT issues. The interim report for this effort analyzed the control of tritium in the quasi-optical transmission line from the IFEL to the tokamak. It was concluded that the use of cryopumping could reduce tritium to the level that it would not pose a breathing hazard in the IFEL vault and that hands-on maintenance would be possible. Preliminary indications were that likely accident scenarios could be handled safely by closing valves between the tokamak and the IFEL. The present report describes the analyses of physics issues associated with the intense microwave fields during heating of CIT. Constraints and opportunities are identified. Details are provided in the appendices about the topics in the following summaries. DOE

N91-18412# Rochester Univ., NY. Lab. for Laser Energetics.
LLE (LABORATORY FOR LASER ENERGETICS) REVIEW Quarterly Report, Jul. - Sep. 1990
S. A. Kumpan, ed. 1990 72 p Sponsored in part by Empire State Electric Energy Research Corp., New York, NY; New York State Energy Research and Development Authority, New York; and Institut de Recherche de l'Hydro-Ontario
(Contract DE-FC03-85DP-40200)
(DE91-005414; DOE/DP-40200/140) Avail: NTIS HC/MF A04

This volume of the LLE Review, covering the period July through September 1990, contains articles in two main sections: the OMEGA Upgrade and Advanced Technology Developments. The first article in Section 1 describes the changes in the overall system design of the 60-beam OMEGA Upgrade since the release of the OMEGA Upgrade Preliminary Design Document in October 1989. It is followed by an article that presents results of an investigation into stimulated rotational Raman scattering as it relates to the propagation of high-fluence ultraviolet laser beams in the OMEGA Upgrade. The third article is a report on the energy-transport measurements made on the multisegmented amplifier (MSA), built as a prototype amplifier for the original OMEGA Upgrade system configuration. The final article in Section 1 describes the design of the 20-cm-clear-aperture, single-segmented amplifier (SSA), which will be the final amplifier in the current OMEGA Upgrade system configuration. Section 2 presents the results to date of an intensive in-house effort at LLE to develop the various optical coatings required for the OMEGA Upgrade. DOE

N91-18413*# David Sarnoff Research Center, Princeton, NJ. Optoelectronics Research Lab.
IMPROVING THE RELIABILITY AND MODAL STABILITY OF HIGH POWER 870 nm AlGaAs CSP LASER DIODES FOR APPLICATIONS TO FREE SPACE COMMUNICATION SYSTEMS Final Report, 19 Aug. 1988 - 1 Oct. 1990
J. C. Connolly, G. A. Alphonse, D. B. Carlin, and M. Ettenberg Washington NASA Mar. 1991 85 p
(Contract NAS1-18226)
(NASA-CR-4345; NAS 1.26:4345) Avail: NTIS HC/MF A05 CSCL 20E

The operating characteristics (power-current, beam divergence, etc.) and reliability assessment of high-power CSP lasers is discussed. The emission wavelength of these lasers was optimized at 860 to 880 nm. The operational characteristics of a new laser, the inverse channel substrate planar (ICSP) laser, grown by metalorganic chemical vapor deposition (MOCVD), is discussed and the reliability assessment of this laser is reported. The highlights of this study include a reduction in the threshold current value for the laser to 15 mA and a degradation rate of less than 2 kW/hr for the lasers operating at 60 mW of peak output power. Author

N91-18414# Sandia National Labs., Albuquerque, NM.
FLUXLESS LASER SOLDERING OF RADAR HOUSINGS
D. M. Keicher and F. M. Hosking 1990 14 p Presented at the JOWOG 22D Joining Subgroup Meeting, Los Alamos, NM, 23-25 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE91-005223; SAND-90-1648C; CONF-9010282-1) Avail: NTIS HC/MF A03

Laser soldering of electronic components is a rapidly maturing technology and has been found to be particularly useful in the attachment of very fine pitch surface mount devices. Conversely, very little progress has been made to extend this technology to other soldering applications. It was the intention of this study to explore the feasibility of utilizing laser soldering to produce hermetic closure joints in radar packages. In producing hermetic joints, several requirements had to be met. It was essential to have a process that would eliminate the potential for entrapment of corrosive flux residues within the radar unit. In addition, it was desirable to create higher strength solder joints than could be produced by conventional step solder techniques which require lower temperature solders to be used in the final closure process. Further, solder mixing of the closure joint solder and solders used on components inside the radar was to be avoided. To fulfill the requirements, the localized heating characteristics of laser soldering made it an obvious choice for this application. DOE

N91-18415# Lawrence Livermore National Lab., CA.
HIGH THRESHOLD HR (HIGHLY REFLECTIVE) COATINGS AT 1064 nm
F. Rainer, F. P. DeMarco, J. T. Hunt, A. J. Morgan, L. P. Mott, F. Marcelja, and M. R. Greenberg (Spectra-Physics Optics Corp., Mountain View, CA.) 17 Dec. 1990 10 p Presented at the 22nd Boulder Damage Symposium, Boulder, CO, 24-26 Oct. 1990
(Contracts W-7405-eng-48; MIPR-W31RPD-0-D4074)
(DE91-006236; UCRL-JC-104970; CONF-9010287-3) Avail: NTIS HC/MF A02

An extensive series of laser damage measurements were conducted on highly reflective (HR) dielectric coatings which have yielded 1064 nm thresholds as high as 40 J/sq cm for 8 to 10 ns pulses at pulse repetition frequencies (PRF) of 10 Hz. Moreover, by laser conditioning these coatings with subthreshold pulses, the thresholds of some coatings were raised to levels exceeding 70 J/sq cm. These are the highest threshold dielectric HR coatings that were tested in this regime. The coatings were originally developed to produce HR-overcoated metal mirrors for free electron laser (FEL) applications at high PRF. The tests included coatings deposited on both dielectric substrates and molybdenum (Mo) substrates. In each category coatings were also examined with a pre-coat of Mo between the substrate and the HR stack. The improved dielectric HR stacks effectively shielded the Mo from the laser irradiation so that the thresholds of virtually all Mo samples exceeded levels of the best dielectric enhanced and dielectric-HR-coated metal mirrors tested to date. In addition to the low PRF measurements, 1064 nm damage tests were also conducted at 6 kHz PRF using 65 ns pulses from the Kilroy damage test facility. The coatings survived thermal loading of fluences ranging from 2 to 10 J/sq cm with respective small spot sizes on the order of 1.2 to 0.3 mm (1/sq e diameter). DOE

N91-18416# Lawrence Livermore National Lab., CA.
COHERENT X RAY LASERS FOR APPLICATIONS
R. A. London, P. Amendt, M. D. Rosen, M. D. Feit, J. A. Fleck, and M. Strauss (Israel Atomic Energy Commission, Negev.) Dec. 1990 9 p Presented at the 2nd International Colloquium on X Ray Lasers, York, England, 17-21 Sep. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006257; UCRL-JC-105731; CONF-9009266-4) Avail: NTIS HC/MF A02

Many of the projected applications of x ray lasers require high quality output radiation with properties such as short wavelength, high power, good focusability, short pulse, and high degree of coherence. The requirements of an x ray laser are discussed for the application of holography of biological samples. Ideas are presented for achieving these properties. Given that population inversions can be established to provide laser gain, how the propagation and amplification of x rays within the lasing medium

affect the quality of the output radiation is given. Particular attention is given toward the development of transverse coherence. Results are presented from several methods for calculating the coherence, including a modal analysis and a numerical-wave propagation code. Calculations of the expected degree of coherence of standard x ray lasers are given, as well as designs for more coherent lasers. DOE

N91-18417# Lawrence Livermore National Lab., CA.
NONLINEAR OPTICS WITH FOCUSED X RAY LASERS
L. B. DaSilva, M. H. Muendel, R. W. Falcone, D. J. Fields, J. B. Kortright, B. J. MacGowan, D. L. Matthews, S. Mrowka, G. M. Shimkaveg, and J. E. Trebes 12 Dec. 1990 5 p Presented at the 2nd International Colloquium on X Ray Lasers, York, England, 17-21 Sep. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006512; UCRL-JC-105492; CONF-9009266-6) Avail: NTIS HC/MF A01

The possibility was investigated of focusing x ray lasers with the use of multilayered mirrors or zone plates. The results indicate that x ray intensities as high as 10(exp 14) W/sq cm can be achieved by focusing saturated Ne-like x ray lasers. These intensities should be adequate for studying nonlinear optical phenomena. DOE

N91-18418# Lawrence Livermore National Lab., CA.
NICKEL-LIKE SOFT X RAY LASERS AT 44.8 ANGSTROM AND 43.1 ANGSTROM
S. Maxon, B. J. MacGowan, S. Dalhed, A. L. Osterheld, R. A. London, M. D. Rosen, C. J. Keane, Peter L. Hagelstein, G. Charatis, and G. Busch (KMS Fusion, Inc., Ann Arbor, MI.) 1990 8 p Presented at the 2nd International Colloquium on X Ray Lasers, York, England, 17-21 Sep. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006513; UCRL-JC-103330; CONF-9009266-5) Avail: NTIS HC/MF A02

Predictions for the gains of the 4p-4d laser lines (0-1, 2-1, 1-1) in Nickel-like Ta and W are compared to the results of experiments. Effects which can resolve the discrepancies are pointed out. DOE

N91-18419# Argonne National Lab., IL. Physics Div.
RECENT DEVELOPMENTS IN LASER-DRIVEN POLARIZED SOURCES
L. Young, K. P. Coulter, R. J. Holt, E. R. Kinney, R. S. Kowalczyk, D. H. Potterveld, and A. Zghiche 1990 5 p Presented at the 9th International Symposium on High Energy Spin-Physics, Bonn, Fed. Republic of Germany, 10-15 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-006600; CONF-900924-11) Avail: NTIS HC/MF A01

Recent progress in the performance of laser-driven sources of polarized hydrogen and deuterium is described. The current status of the prototype source, I = 2.5 times 10(exp 17)s(exp -1), polarization = 0.29 (including atomic fraction), is comparable to classical Stern-Gerlach sources. A scheme to improve source performance by approximately an order of magnitude, using a combination of optical-pumping spin-exchange and RF transitions, is outlined. DOE

N91-18420# Lawrence Livermore National Lab., CA.
STUDIES OF DEGENERATE AND NEARLY DEGENERATE FOUR WAVE MIXING OF LASER RADIATION IN PLASMAS Final Report, 7 Jun. 1989 - 6 Aug. 1990
Chan Joshi (California Univ., Los Angeles.) Dec. 1990 26 p
(Contract W-7405-eng-48)
(DE91-006682; UCRL-CR-105907) Avail: NTIS HC/MF A03

Optical Phase Conjugation is an area of nonlinear optics with a wide variety of potential applications. One method of generating a phase conjugate signal is with four wave mixing (FWM). In FWM, three input beams interact in a nonlinear medium, and a fourth beam is produced that is the phase conjugate of one of the input waves. Degeneate Four Wave Mixing (DFWM) is a special case of FWM in which all of the beams are at the same frequency. In a plasma, DFWM is an effective technique for phase conjugation in high density, low temperature plasmas. One way of enhancing the phase conjugate signal over and above the DFWM level is with Resonant Four Wave Mixing (RFWM), in which two of the input beams beat at a plasma resonance. In addition to enhancing the generated wave, RFWM can also serve as a diagnostic for many plasma parameters, such as the electron and ion temperatures, the ion acoustic velocity, and the damping rate. In this report, experimental evidence of RFWM with CO2 laser radiation is presented, and the data is compared with theoretical predictions. DOE

N91-18421# Norwegian Defence Research Establishment, Kjeller.
A STUDY OF A TITANIUM DOPED SAPPHIRE LASER
Halvor Rolf Ajer 25 Sep. 1990 112 p
(FFI-90/7040; ISSN-0802-2437; ETN-91-98626) Avail: NTIS HC/MF A06

Theoretical and experimental studies of titanium doped sapphire as a laser material are presented. The spectroscopy of titanium doped sapphire was investigated theoretically using group theory in order to obtain a qualitative understanding of the physics of the medium. This includes the influence of the crystal field on the energy levels of the titanium doped ion as well as electronic relection rules. An illustration of how the vibronic transitions cause the broad spectra of titanium doped sapphire is given. A pulsed titanium doped sapphire laser longitudinally pumped by a frequency doubled, Q switched Nd:YAG laser was built and theoretically modeled. Results of the numerical simulations compared well with the experimental results. The efficiency was over a factor two below the theoretical limit given by the ratio of the pump and laser wavelengths. This was caused by resonator losses and non-perfect overlap of the pump and resonator modes. Typical output pulse energies were around 0.5 mJ. A birefringent filter was used for wavelength tuning. Tuning was demonstrated in the ranges 720 to 880 nm and 920 to 1020 nm using two different mirror sets. By lowering the resonator losses and using other mirrors in the resonator, the tuning range could be extended. ESA

N91-18422# Royal Signals and Radar Establishment, Malvern (England).
LONG SELF-SUSTAINED DISCHARGE PULSES FOR CO2 LASERS: FURTHER SKIRMISHES
M. R. Harris Aug. 1990 20 p
(RSRE-MEMO-4415; BR115324; ETN-91-98627) Copyright Avail: NTIS HC/MF A03

Non-externally sustained glow discharges of 10.8 and 26.25 microsecond duration are operated in CO2 laser gas mixtures over a pressure range 0.3 to 1 atmosphere. The effects of gas mixture, pressure and pulse length are characterized and the infuence of CO2 dissociation products on the discharge are examined along with measurements of the dissociation rate of CO2. ESA

N91-18423*# Johns Hopkins Univ., Baltimore, MD. Dept. of Electrical and Computer Engineering.
AVALANCHE PHOTODIODE PHOTON COUNTING RECEIVERS FOR SPACE-BORNE LIDARS Progress Report, 1 Mar. 1990 - 28 Feb. 1991
Xiaoli Sun and Frederic M. Davidson Mar. 1991 57 p
(Grant NAG5-356)
(NASA-CR-187991; NAS 1.26:187991) Avail: NTIS HC/MF A04 CSCL 20E

Avalanche photodiodes (APD) are studied for uses as photon counting detectors in spaceborne lidars. Non-breakdown APD photon counters, in which the APD's are biased below the breakdown point, are shown to outperform: (1) conventional APD photon counters biased above the breakdown point; (2) conventional APD photon counters biased above the breakdown point; and (3) APD's in analog mode when the received optical signal is extremely weak. Non-breakdown APD photon counters were shown experimentally to achieve an effective photon counting quantum efficiency of 5.0 percent at lambda = 820 nm with a

dead time of 15 ns and a dark count rate of 7000/s which agreed with the theoretically predicted values. The interarrival times of the counts followed an exponential distribution and the counting statistics appeared to follow a Poisson distribution with no after pulsing. It is predicted that the effective photon counting quantum efficiency can be improved to 18.7 percent at lambda = 820 nm and 1.46 percent at lambda = 1060 nm with a dead time of a few nanoseconds by using more advanced commercially available electronic components. Author

N91-18424# Dortmund Univ. (Germany, F.R.).
THE INTERACTION OF FREE ELECTRON LASERS AND STORAGE RINGS, ANALYZED WITH A MAPPING ALGORITHM FOR DISTRIBUTED FUNCTIONS Ph.D. Thesis
Volker Ziemann Feb. 1990 161 p
(Contract BMFT-05-AX-334-B2)
(DELTA-IR-90-03; ETN-91-98790) Avail: NTIS HC/MF A08

A model for the simulation of the time dependent behavior and the analysis of the equilibrium of the coupled system of storage ring and Free Electron Laser (FEL) is presented. The analysis comprises both amplifier and oscillator FEL. Bunch lengthening and energy widening due to wake forces are taken into account in a self consistent way. The method is based on a mapping algorithm for means and standard deviations of the electron distribution function, pioneered by K. Hirata. The evolution of the laser field in the oscillator FEL is described by supermodes. The model is used to simulate a FEL in a small 500 MeV storage ring with 100 m circumference. Typical values for the output power, spatial and spectral characteristics of the emitted radiation are derived. ESA

N91-18425# Lawrence Livermore National Lab., CA.
THE MUTUAL COHERENCE OF SIMULTANEOUSLY INJECTION-LOCKED LASER DIODE ARRAYS
L. R. Brewer 22 Apr. 1990 5 p Presented at the Conference on Lasers and Electro-Optics, Anaheim, 21-25 May 1990
(Contract W-7405-eng-48)
(DE91-007337; UCRL-JC-103604; CONF-900530-10) Avail: NTIS HC/MF A01

The modulus of the mutual coherence function, (g sub 12 (tau)), has been measured for two physically separated laser diode arrays that were simultaneously injection locked to the same master laser. The measured value, (g sub 12 (tau)) = 0.96 +/- 0.06, is close to ideal. DOE

N91-18426# Lawrence Livermore National Lab., CA.
HYDROGEN-LIKE RECOMBINATION X RAY LASER EXPERIMENTS USING A 20 PICOSECOND LASER PULSE AT THE NOVA FACILITY
R. Shephard, D. J. Fields, L. B. DaSilva, C. J. Keane, B. J. MacGowan, D. L. Matthews, G. M. Shimkaveg, G. Stone, D. Eder, and A. L. Osterheld et al Jan. 1991 6 p Presented at the 2nd International Colloquium on X Ray Lasers, York, England, 17-21 Sep. 1990
(Contract W-7405-eng-48)
(DE91-007343; UCRL-JC-104647; CONF-9009266-9) Avail: NTIS HC/MF A02

Hydrogen-like recombination x ray lasers are currently under investigation as an alternative candidate to collisional pumped soft x ray amplifiers. Efforts are being concentrated on the n = 3 to n = 2 transitions in H-like Mg and NaF. DOE

N91-18427# Lawrence Livermore National Lab., CA.
SHORT WAVELENGTH NICKEL-LIKE X RAY LASER DEVELOPMENT
B. J. MacGowan, L. B. DaSilva, D. J. Fields, A. R. Fry, C. J. Keane, J. A. Koch, D. L. Matthews, M. S. Maxon, S. Mrowka, and A. L. Osterheld et al Jan. 1991 12 p Presented at the 2nd International Colloquium on X Ray Lasers, York, England, 17-21 Sep. 1990
(Contract W-7405-eng-48)
(DE91-007344; UCRL-JC-105032; CONF-9009266-8) Avail: NTIS HC/MF A03

Ni-like x ray lasers have been produced at wavelengths near to, and below the carbon K edge (43.76 A). Recent work has concentrated on the development of the Ni-like Ta amplifier at 44.83 A. Amplification occurs in a laser produced plasma created by irradiating a thin foil of Ta with two beams of the Nova laser. Up to 8 gainlengths have been demonstrated so far, with a gain coefficient of 3.2/cm and a gain duration of 250 psec. The wavelength of 44.83 A is close to optimal for holographic imaging of live cells. It remains to optimize the coherent output power of the amplifier to use it as a source for future x ray holography experiments. DOE

N91-18428# Los Alamos National Lab., NM.
FREE-ELECTRON LASER SOURCES OF EXTREME-ULTRAVIOLET RADIATION AND THEIR VACUUM REQUIREMENTS
B. E. Newnam 1990 23 p Presented at the Vacuum Design of Advanced Synchrotron Light Sources, Argonne, 13-15 Nov. 1990
(Contract W-7405-eng-36)
(DE91-007400; LA-UR-91-177; CONF-901144-1) Avail: NTIS HC/MF A03

Recent development of free-electron laser (FEL) component technologies should enable these devices to operate in the extreme-ultraviolet, well below 100 nm. When fully developed, FELs represent the next generation of coherent-radiation sources with peak- and average-power outputs surpassing those of any existing, continuously tunable photon source by many orders of magnitude. An RF-linac-based, multiple-FEL facility, spanning the spectral range from 1 nm to 100 microns is proposed. To enable such a facility to operate without significant degradation over long periods, contamination of certain of the FEL components must be prevented. Requirements for ultra-high vacuum and restricted contamination from outgassing from chamber walls are discussed. DOE

N91-18429# Los Alamos National Lab., NM.
PROGRESS IN SOLID STATE DYE LASER DEVELOPMENT
R. E. Hermes 1990 9 p Presented at the International Conference on Lasers '90, San Diego, 10-14 Dec. 1990
(Contract W-7405-eng-36)
(DE91-007401; LA-UR-91-203; CONF-901263-3) Avail: NTIS HC/MF A02

A triaxial flashlamp (15 cm) was used to optically pump laser rods prepared from an acrylate based copolymer (0.95 cm O.D. x 10.0 cm L.). The performance of 13 laser dyes incorporated into this polymeric solid host is reported. The best lasing performance was obtained with sulforhodamine-B, with a calculated slope efficiency of 0.52 percent and a maximum single pulse output energy of 580 mJ. A commercially available fluorescent polymeric material was also evaluated. DOE

N91-18430# Los Alamos National Lab., NM.
PULSED POWER CONSIDERATIONS FOR ELECTRON BEAM PUMPED KRYPTON FLUORIDE LASERS FOR INERTIAL CONFINEMENT FUSION APPLICATIONS
E. A. Rose, T. E. McDonald, L. A. Rosocha, D. B. Harris, J. A. Sullivan, and I. D. Smith (Pulse Sciences, Inc., San Leandro, CA.) 1991 14 p Presented at the 4th OE/LASE '91 Society of Photo-Optical Instrumentation Engineers (SPIE) International Symposium, Los Angeles, 20-25 Jan. 1991
(Contract W-7405-eng-36)
(DE91-007471; LA-UR-91-256; CONF-910123-8) Avail: NTIS HC/MF A03

The Los Alamos National Laboratory inertial confinement fusion (ICF) program is developing the krypton-fluoride excimer laser for use as an ICF driver. The KrF laser has a number of inherent characteristics that make it a promising driver candidate, such as short wavelength (0.25 microns), broad bandwidth to target (greater than 100 cm(exp -1), pulse-shaping with high dynamic range, and the potential for high overall efficiency (greater than 5 percent) and repetitive operation. The large KrF laser amplifiers needed for ICF drivers are electron-beam pumped. A key issue for all laser ICF drivers is cost, and a leading cost component of a KrF

laser driver is associated with the pulsed power and electron diode. Therefore, the efficient generation of electron beams is a high priority. The Los Alamos ICF program is investigating pulsed-power and diode designs and technologies to further the development of affordable KrF laser ICF drivers. DOE

N91-18431# Los Alamos National Lab., NM.
ALL-OPTICAL PULSE SWITCHING AND SHAPING BY A NONLINEAR SANDWICH
K. Strobl and I. Golub 1991 7 p Presented at the International Conference on Lasers '90, San Diego, CA, 10-14 Dec. 1990
(Contract W-7405-eng-36)
(DE91-007482; LA-UR-91-341; CONF-901263-5) Avail: NTIS HC/MF A02

We demonstrate a simple model system comprised of a thin nonlinear layer sandwiched between two glass plates. This double nonlinear interface allows the investigation of both the transmitted and reflected beams for all-optical switching. Various potential applications of this nonlinear sandwich based on its intensity-dependent reflectivity and transmissivity are discussed. Focus is given to energy limiting, prepulse suppression, pulse shortening, and shaping. Experimental results show feasibility of these applications. DOE

N91-18432# Los Alamos National Lab., NM.
THE PHYSICS OF DYE LASER AMPLIFIERS
C. C. Jensen 1990 9 p Presented at the International Conference on Lasers '90, San Diego, CA, 10-14 Dec. 1990
(Contract W-7405-eng-36)
(DE91-007489; LA-UR-91-363; CONF-901263-4) Avail: NTIS HC/MF A02

This paper describes a method for the complete analysis of the optical properties of a laser dye. The analysis uses direct measurements of the saturation intensities for absorption and emission. The complete analysis of an ultraviolet laser dye, 3,5,3,5-Tetra-t-butyl-p-sexiphenyl, demonstrates the power of the saturation analysis method. The dye TBS exhibits some unique optical properties which affect its emission wavelength range and photochemistry. DOE

N91-18433# California Univ., Berkeley. Lawrence Berkeley Lab.
STABILITY AND PERFORMANCE OF CDRL-FEL (CHEMICAL DYNAMICS RESEARCH LABORATORY-FREE ELECTRON LASER)
K. J. Kim and M. Xie Nov. 1990 37 p Presented at the 12th International Free Electron Laser Conference (FEL-12), Paris, France, 17-21 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-007691; LBL-29853; CONF-9009166-16) Avail: NTIS HC/MF A03

We study the performance of a proposed infrared free electron laser at Lawrence Berkeley Laboratory, which would be a user facility and therefore has a unique set of requirements in intensity, spectrum and stability. The output performance in intensity and spectrum, and methods to optimize the performance, are studied in detail. The effect of the electron beam fluctuation on FEL stability is carefully evaluated to set a tolerance for the accelerator design. Use of intracavity gratings is studied as a means of further improving the spectral purity and stability. DOE

N91-18434# California Univ., Berkeley. Lawrence Berkeley Lab.
AUTOMATIC TRACKING OF THE INTERSECTION OF A LASER AND ELECTRON BEAM
B. T. Turko, R. Z. Fuzesy, D. A. Pripstein, M. Kowitt, O. Chamberlain, G. Shapiro, and E. Hughes (Stanford Linear Accelerator Center, CA.) May 1990 4 p Presented at the 1990 IEEE Nuclear Science Symposium, Arlington, 23-27 Oct. 1990
(Contract DE-AC03-76SF-00098)
(DE91-007740; LBL-29017; CONF-9010220-24) Avail: NTIS HC/MF A01

For the Compton Polarimeter experiment at the Stanford Linear Accelerator the crossing point of a laser beam and an electron beam must be kept accurate and stable. An electronic system is described for the automatic tracking and correcting of the beam crossing. A remote charge coupled device (CCD) camera, relatively insensitive to electromagnetic disturbance, records small displacements of the pulsed laser beam. Video signals are analyzed at a remote station, the amount of drift from a selected reference point determined and the appropriate correction commands sent to the motorized mirror deflecting the laser beam. A description of the system, its performance and the test results are presented. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N91-18435*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
BLADE TIP RUBBING STRESS PREDICTION Final Report
Gary A. Davis and Ray C. Clough 28 Jan. 1991 172 p Original contains color illustrations
(Contract NAS3-36361)
(NASA-CR-184100; NAS 1.26:184100; RI/RD-91-114) Avail: NTIS HC/MF A08; 13 functional color pages CSCL 13I

An analytical model was constructed to predict the magnitude of stresses produced by rubbing a turbine blade against its tip seal. This model used a linearized approach to the problem, after a parametric study, found that the nonlinear effects were of insignificant magnitude. The important input parameters to the model were: the arc through which rubbing occurs, the turbine rotor speed, normal force exerted on the blade, and the rubbing coefficient of friction. Since it is not possible to exactly specify some of these parameters, values were entered into the model which bracket likely values. The form of the forcing function was another variable which was impossible to specify precisely, but the assumption of a half-sine wave with a period equal to the duration of the rub was taken as a realistic assumption. The analytical model predicted resonances between harmonics of the forcing function decomposition and known harmonics of the blade. Thus, it seemed probable that blade tip rubbing could be at least a contributor to the blade-cracking phenomenon. A full-scale, full-speed test conducted on the space shuttle main engine high pressure fuel turbopump Whirligig tester was conducted at speeds between 33,000 and 28,000 RPM to confirm analytical predictions. Author

N91-18436*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AN EVALUATION OF BEARINGS OPERATING IN A CRYOGENIC ENVIRONMENT WITH SILICON NITRIDE ROLLING ELEMENTS
H. G. Gibson Jan. 1991 21 p
(NASA-TM-103524; NAS 1.15:103524) Avail: NTIS HC/MF A03 CSCL 13I

The bearings used in the space shuttle main engine (SSME) high pressure oxidizer turbopump (HPOTP) do not meet the expected life goals that were set for them. In an effort to improve their performance, many solutions are being studied. New bearing materials are being developed, better manufacturing techniques are being investigated, and improved cage materials for better lubrication are being tested. The focus is on the replacement of steel balls with ones made of silicon nitride in 57-mm HPOTP bearings. The bearings were then installed in a test rig and run at near turbopump operating conditions. The results from this test series are encouraging, with silicon nitride showing good wear resistance and thermal stability. Author

N91-18437# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
THE DYNAMICS OF DROPLET FORMATION AND DETACHMENT IN GAS METAL ARC WELDING

John A. Johnson, Herschel B. Smartt, Denis E. Clark, Nancy M. Carlson, Arthur D. Watkins, and Bryan J. Lethcoe 1990 9 p Presented at the Modeling of Casting, Welding and Advanced Solidification Processes Engineering Foundation Conference, Davos, Switzerland, 16-21 Sep. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006130; EGG-M-90058; CONF-9009258-2) Avail: NTIS HC/MF A02

Experimental measurements of gas metal arc welding are required for the development and confirmation of models of the process. This paper reports on two experiments that provide information for models of the arc physics and of the weld pool dynamics. The heat transfer efficiency of the spray transfer mode in gas metal arc welding was measured using a calorimetry technique. The efficiency varied from 75 to 85 percent. A special fixture was used to measure the droplet contribution, which is determined to be between 35 and 45 percent of the total input energy. A series of experiments was performed at a variety of conditions ranging from globular to spray to streaming transfer. The transfer was observed by taking high-speed movies at 500 to 5000 frames per second of the backlighted droplets. An automatic image analysis system was used to obtain information about the droplets including time between detachments, droplet size, and droplet acceleration. At the boundary between the globular and spray modes, the droplet size varies between small droplets that melt off faster than average, resulting in a smaller electrode extension, and large droplets that melt off slower than average, resulting in an increase in the electrode extension. DOE

N91-18438# Sandia National Labs., Albuquerque, NM.
LARGE-STRAIN QUASI-STATIC COMPRESSION MATERIALS TESTS IN SUPPORT OF PENETRATION MODELING RESEARCH
S. L. Brandon and J. J. Totten Sep. 1990 20 p
(Contract DE-AC04-76DP-00789)
(DE91-004147; SAND-90-8231) Avail: NTIS HC/MF A03

Target penetration by projectiles typically generates large strains, at least locally. Hence, accurate analytic modeling of penetration demands that constitutive models be calibrated using large strain material test data. Tensile test data is limited by specimen necking (the Considere criterion), restricting attainable strains. Linear extrapolation of tensile data to target strains can seriously overestimate the material flow stress, resulting in erroneously stiff analytical predictions. That is, other tests which can attain larger strains often reveal a continually decreasing tangent modulus at large strains. We report quasistatic room temperature compression tests approaching true strains of epsilon = -1. A few tensile tests are included to illustrate the previous point. Materials tested are 7075-T651, 5083-H131, and 6061-T651 aluminum alloys and 4340 steel and X21-C tungsten alloy. DOE

N91-18439# Idaho National Engineering Lab., Idaho Falls.
A MODEL-BASED APPROACH TO INTELLIGENT CONTROL OF GAS METAL ARC WELDING
Herschel B. Smartt, J. A. Johnson, C. J. Einerson, Arthur D. Watkins, and Nancy M. Carlson 1990 8 p Presented at the Modeling of Casting, Welding, and Advanced Solidification Processes Engineering Foundation Conference, Davos, Switzerland, 16-21 Sep. 1990
(Contract DE-AC07-76ID-01570)
(DE91-006170; EGG-M-89511; CONF-9009258-3) Avail: NTIS HC/MF A02

This paper discusses work on a model-based intelligent process controller for gas metal arc welding. Four sensors input to a neural network, which communicates to a reference model-based adaptive controller that controls process parameters. Reference model derivation and validation are discussed. The state of an arch weld is determined by the composition of the weld and base metal and the weld's thermomechanical history. The composition of the deposited weld metal depends primarily on the amount of filler metal dilution; heat input to the weld, comprising pre-heat and process heat, is the controlling factor in the thermal cycle. Thus, control of the arc welding process should focus on rational specification and in-process control of the heat and mass input to the weld. A control model has been developed in which the governing equations are solved for the process parameters as functions of the desired heat input (in terms of heat input unit weld length) and mass input (in terms of transverse reinforcement area) to the weld. The model includes resistive and arc heating of the electrode wire, characteristics of the welding power supply, and a volumetric heat balance on the electrode material, as well as latent and superheat of the electrode material. Extension of the model to include dynamics of individual droplet transfer events, based on incorporating a nonlinear, lumped parameter droplet analysis, is discussed. A major emphasis has been placed on computational simplicity; model solutions are required at the rate of about 10 Hz during welding. Finally, a process control scheme has been developed for the gas metal arc welding process using the above nonlinear model with a proportional-integral controller with adaptive coefficients to control the weld heat input and reinforcement area independently. Performance of the resulting control method is discussed. DOE

N91-18440# Technische Hochschule, Darmstadt (Germany, F.R.).
PARAMETER EVALUATION AND DIGITAL ADAPTIVE REGULATION OF AN INDUSTRIAL ROBOT Ph.D. Thesis [PARAMETERSCHAETZUNG UND DIGITALE ADAPTIVE REGELUNG EINES UNDUSTRIEROBOTERS]
Rolf Specht 1989 299 p In GERMAN
(ETN-91-98793) Avail: NTIS HC/MF A13

The possible utilization of parameter evaluation processes was examined, with a view to efficient new regulation concepts for industrial robots. A controlled parameter adaptive regulation concept was developed, in which the practical points of view of an industrial robot control were taken into consideration. A mathematical model was performed for the robot mechanics. The parameter evaluation was based on the least error square method. The measure recursive lattice algorithms were examined to see which could be used for industrial robot evaluation. Results from industrial robot regulation investigation and simulation showed that the adaptation to the time variant moment of inertia could lead to an improvement of the control effectiveness, compared to conventional regulation. ESA

N91-18441# EG and G Mound Applied Technologies, Miamisburg, OH.
BEARING STAKING PROCESS INVESTIGATION USING A DESIGNED EXPERIMENT
K. P. Armstrong 21 Dec. 1990 29 p
(Contract DE-AC04-88DP-43495)
(DE91-006280; MLM-3674) Avail: NTIS HC/MF A03

A designed experiment was performed on the staking operation of a miniature precision bearing. Three variables were controlled during the experiment: staking force, tool diameter, and bearing-to-wheel fit. The study showed that the current staking tool diameter is highly sensitive to staking force and to bearing-to-wheel fit, whereas a smaller diameter tool is not. The study also shows that, with the current process, bearing movement under a 100-Newton (N) force can be estimated at 0.009 in. to 0.0029 in. The current specification is 0.002 in. and should be revised to 0.0035 in. DOE

N91-18442# Oak Ridge National Lab., TN.
CONTROL OF A TELEOPERATOR SYSTEM WITH REDUNDANCY BASED ON PASSIVITY CONDITIONS
J. F. Jansen and R. L. Kress 1991 8 p Presented at the IEEE Robotics and Automation Conference, Sacramento, 7-12 Apr. 1991
(Contract DE-AC05-84OR-21400)
(DE91-007679; CONF-910451-12) Avail: NTIS HC/MF A02

The purpose of this paper is to examine how a stiffness controller can be used to control a teleoperator system having a redundant degree-of-freedom (dof) slave manipulator and a dissimilar master. No path planning was allowed because the uncertainty of the environment and computational limitations. The

proposed controller was implemented on the 7-dof Center for Engineering Systems Advanced Research Manipulator (CESARm) slave manipulator with a 6-dof Kraft master manipulator. The overall performance of this scheme and future directions are discussed.
DOE

N91-18130*# Florida Agricultural and Mechanical Univ., Tallahassee. Coll. of Engineering.
LUNAR ARTICULATED REMOTE TRANSPORTATION SYSTEM
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 55-59 Prepared in cooperation with Florida State Univ., Tallahassee (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13F

N91-18131*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
LUNAR SURFACE VEHICLE MODEL COMPETITION
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 61-62 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13F

N91-18140*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
WALKING ROBOT: A DESIGN PROJECT FOR UNDERGRADUATE STUDENTS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 117-122 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13I

N91-18147*# Old Dominion Univ., Norfolk, VA.
DESIGN OF AN AUTONOMOUS LUNAR CONSTRUCTION UTILITY VEHICLE
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 169-173 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 13B

N91-18978*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
DAMPER BEARING ROTORDYNAMICS
David A. Elrod *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

N91-18979*# Alabama Univ., Tuscaloosa. Dept. of Mechanical Engineering.
MECHANICAL DESIGN PROBLEMS ASSOCIATED WITH TURBOPUMP FLUID FILM BEARINGS
Charles R. Evces *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

N91-18980*# Auburn Univ., AL. Dept. of Mechanical Engineering.
DISK FLEXIBILITY EFFECTS ON THE ROTORDYNAMICS OF THE SSME HIGH PRESSURE TURBOPUMPS
George T. Flowers *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

N91-19006*# Alabama Univ., Huntsville. Dept. of Civil Engineering.
THE EFFECT OF FRICTION IN THE HOLD DOWN POST SPHERICAL BEARINGS ON HOLD DOWN POST LOADS
James A. Richardson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 13K

N91-19013*# Wichita State Univ., KS. Dept. of Mechanical Engineering.
HEAT SINK EFFECTS IN VPPA WELDING
Paul O. Steranka, Jr. *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N91-18443*# Illinois Univ., Urbana-Champaign. Dept. of General Engineering.
ACOUSTO-ULTRASONIC EVALUATION OF CERAMIC MATRIX COMPOSITE MATERIALS Final Report
Henrique L. M. dosReis Feb. 1991 24 p
(Grant NAG3-798)
(NASA-CR-187073; NAS 1.26:187073) Avail: NTIS HC/MF A03 CSCL 14D

Acousto-ultrasonic nondestructive evaluation of ceramic composite specimens with a lithium-alumino-silicate glass matrix reinforced with unidirectional silicon carbide (NICALON) fibers was conducted to evaluate their reserve of strength. Ceramic composite specimens with different amount of damage were prepared by four-point cyclic fatigue loading of the specimens at 500 C for a different number of cycles. The reserve of strength of the specimens was measured as the maximum bending stress recorded during four-pointed bending test with the load monotonically increased until failure occurs. It was observed that the reserve of strength did not correlate with the number of fatigue cycles. However, it was also observed that higher values of the stress wave factor measurements correspond to higher values of the reserve of strength test data. Therefore, these results show that the acousto-ultrasonic approach has the potential of being used to monitor damage and to estimate the reserve of strength of ceramic composites. Author

N91-18011# Wichita State Univ., KS. Dept. of Mechanical Engineering.
NEURAL NETWORKS IN FLAW DETECTION Abstract Only
Behnam Bahr and Nabeel Tarabishy *In its* Proceedings: Techfest 17 1991 p 8 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEVELOPMENT AND APPLICATIONS OF NONDESTRUCTIVE EVALUATION AT MARSHALL SPACE FLIGHT CENTER
Ann F. Whitaker *In its* Second Conference on NDE for Aerospace Requirements Dec. 1990 p 15-24 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 14D

N91-18193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACOUSTO-ULTRASONIC NONDESTRUCTIVE EVALUATION OF MATERIALS USING LASER BEAM GENERATION AND DETECTION
Robert D. Huber, Robert E. Green, Jr. (Johns Hopkins Univ., Baltimore, MD.), Alex Vary, and Harold Kautz *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 51-82 (For primary document see N91-18189 10-18)

(Grant NAG3-728)
Avail: NTIS HC/MF A13 CSCL 14D

N91-18195*# Oak Ridge National Lab., TN.
EDDY-CURRENT INSPECTION OF SHUTTLE HEAT EXCHANGER TUBE WELDS
Casius V. Dodd, G. W. Scott (Martin Marietta Corp., New Orleans, LA.), and L. D. Chitwood *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 107-12 Previously announced as N90-15462 (For primary document see N91-18189 10-18)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A13 CSCL 14D

N91-18197*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ULTRASONIC CORRELATOR VERSUS SIGNAL AVERAGER AS A SIGNAL TO NOISE ENHANCEMENT INSTRUMENT
Doron Kishoni and Benjamin E. Pietsch (Industrial Quality, Inc., Gaithersburg, MD.) *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 187-19 Previously announced in IAA as A91-19665 (For primary document see N91-18189 10-18)
Avail: NTIS HC/MF A13 CSCL 14D

N91-18198*# Martin Marietta Corp., Huntsville, AL.
AN AUTOMATIC GORE PANEL MAPPING SYSTEM
John D. Shiver and Norman N. Phelps *In* NASA, Marshall Space Flight Center, Second Conference on NDE for Aerospace Requirements Dec. 1990 p 264-26 (For primary document see N91-18189 10-18)
(Contract NAS8-30300)
Avail: NTIS HC/MF A13 CSCL 14D

N91-18975*# Middle Tennessee State Univ., Murfreesboro. Dept. of Mathematics and Statistics.
IS IT POSSIBLE TO IDENTIFY A TREND IN PROBLEM/FAILURE DATA
Curtis K. Church *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N91-18444 Princeton Univ., NJ.
ON THE WELL-POSEDNESS OF THE INITIAL VALUE PROBLEM IN ELASTO-PLASTODYNAMICS Ph.D. Thesis
Haluk Ors 1990 101 p
Avail: Univ. Microfilms Order No. DA9024540

The set of partial differential equations expressing the balance of linear momentum in mechanics together with appropriate constitutive assumptions and initial and boundary data constitutes Cauchy's problem. The well posedness of the linearized Cauchy's problem in solid elasto-plastodynamics is examined. A review is given of previous research in the settling of this question in elastodynamics. This review is relevant to the more general case of elasto-plastodynamics because the sets of equations governing both phenomena are basically the same. The initial value problem was studied in its most general form by using a recent technique by Kreiss. The cases were considered of elastic and elastic-plastic materials with associated and nonassociated plastic flow rules. Nonassociativity of the flow rule leads to the loss of major symmetry of the material constitutive tensor. The analysis is carried under the assumption that the material response remains the same constitutive cone everywhere. This is a common simplifying assumption used in plastic theory. Kreiss theory allows a complete answer to the well posedness question which does not require major symmetry of the constitutive tensor unlike previous proofs. Dissert. Abstr.

N91-18445*# McDonnell-Douglas Helicopter Co., Mesa, AZ.
PLAN, FORMULATE, AND DISCUSS A NASTRAN FINITE ELEMENT MODEL OF THE AH-64A HELICOPTER AIRFRAME
Richard A. Christ, Douglas A. Ferg, Kevin A. Kilroy, Mostafa Toossi, and Richard K. Weisenburger Oct. 1990 111 p
(Contract NAS1-17498)
(NASA-CR-187446; NAS 1.26:187446) Avail: NTIS HC/MF A06 CSCL 20K

A discussion of modeling plan objectives, followed by a description of the AH-64A aircraft including all general features, major components, and primary and structure definitions are presented. Following the aircraft description, a discussion of the modeling guidelines and model checkout procedure are provided. The NASTRAN finite element analysis is set up to be suitable to predict both static internal loads and vibrations. Finally, the results, schedule, and planned versus actual manhours for this work are presented. Author

N91-18446 Michigan Univ., Ann Arbor.
THE USE OF FUNCTION GENERATION IN THE REAL-TIME SIMULATION OF STIFF SYSTEMS Ph.D. Thesis
Kuo-Chi Lin 1990 158 p
Avail: Univ. Microfilms Order No. DA9034470

One of the most difficult real time simulation problems is the simulation of stiff dynamic systems. These systems are governed by equations, when linearized, have eigenvalues that are widely separated. A new approach, the function generation method, is suggested. The equations of the fast subsystem are integrated off line over a time interval which will be used as the step size for the on line integration of the slow subsystem. This off line integration uses a sufficiently small step size to insure both accurate and stable solutions and is repeated for a matrix of initial conditions and inputs. These results are then stored in multivariable function tables. A time shift scheme is also introduced. In this scheme, the frame times for the fast subsystem are shifted half an integration step with respect to the integer frame times for the slow subsystem. This, in turn, means that the output data sequences of the fast and slow subsystems are staggered by 1/2 of an integration step with respect to each other. This scheme provides substantial improvement in accuracy in both methods. Three practical examples are used to demonstrate how the function generation method is implemented. Dissert. Abstr.

N91-18447 Texas Univ., Austin.
ON THE INITIATION AND PROPAGATION OF LOCALIZED INSTABILITIES IN LONG TUBES UNDER INTERNAL PRESSURE AND AXIAL TENSION Ph.D. Thesis
Yu-Chung Chang 1990 178 p
Avail: Univ. Microfilms Order No. DA9031537

In a number of applications the load bearing capacity of solids and structures is limited by instabilities which initiate at a point and then propagate over the rest of the structure which results in catastrophic failure. Experimental and analytical results are presented from an example which illustrates the mechanics of initiation and propagation of such instabilities. The example is an internally pressurized long rubber tube. The initiation process involves the onset and localization of an instability. Latex rubber tubes of various lengths were inflated by volume control at various values of applied axial force. In each experiment, the deformation was recorded through a video recorder and retrieved through image processing. The instability localization and transformation of the initially local budge to a budge that propagates was illustrated. The localization and propagation pressure and the associated configurations were found to vary with the axial force applied. The problem was formulated and analyzed numerically through an axisymmetric membrane analysis. The calculated and measured results were found to be generally in good agreement. A similar

analysis of the steady state quasi-static propagation was also conducted. Dissert. Abstr.

N91-18448 Purdue Univ., West Lafayette, IN.
CONTROL OF SECOND-ORDER INFORMATION FOR LINEAR SYSTEMS Ph.D. Thesis
Chen Hsieh 1990 196 p
Avail: Univ. Microfilms Order No. DA9031339

Four controller design problems for linear systems are addressed that have several common features: (1) they are multi-objective designs; (2) performance specifications and system uncertainties, if any, are given a priori; and (3) they have equivalent deterministic and stochastic meaning. In the covariance assignment problem, the whole set of steady state covariance, X, that a closed-loop discrete system can possess is obtained. Furthermore, all controllers which assign this X to the system are parameterized in a closed form. In the output variances constrained (OVC) control problem, the minimum energy controller is designed to achieve prespecified output constraint. Necessary and sufficient conditions are derived for the optimal solution. A simple algorithm to solve this problem is also given. Instead of designing based on the nominal plant, the robust output variances constrained (ROVC) control problem considers the perturbations in the plant. The performance specifications required are the same as those in the OVC problem but should be satisfied for all admissible plants. A complete algorithm solving this problem is given. In this design, the admissible set, which is given a priori, is treated as a guide for this design algorithm. With the help of this guide, starting with a stability robust controller carefully tunes the performance robustness of the closed loop system while maintaining the stability robustness. By noting that an output weighting matrix is the main design parameter for both the OVC algorithm and model reduction by modal cost analysis (MCA), a design strategy is proposed which integrates both modeling and controller synthesis. This design strategy is applied to NASA's Mini-Mast system, a standard large space structure, and successful results are obtained.
Dissert. Abstr.

N91-18449# Los Alamos National Lab., NM.
ELASTIC SHEAR MODULUS: FITS TO DATA AND EXTRAPOLATION TO LARGE COMPRESSIONS AND NEGATIVE PRESSURE
Galen K. Straub Dec. 1990 11 p
(Contract W-7405-eng-36)
(DE91-005996; LA-11806-MS) Avail: NTIS HC/MF A03

An analytic form for the elastic shear modulus is presented and its fit to data at different compressions is demonstrated for copper and tungsten. When only shear modulus at zero pressure and its logarithmic derivative are known, an approximate procedure is used to generate the parameters for an analytic form for the shear modulus. This procedure is demonstrated, and estimates are provided of the shear modulus as a function of compression, for Al, Cu, Fe, Mo, W, Ta, and U. DOE

N91-18450# Materials Research Labs., Ascot Vale (Australia).
ANALYTICAL CALCULATIONS OF FATIGUE LOADING OF SUBMARINE HULLS
I. M. Robertson 1990 76 p
(MRL-TR-90-26; AR-006-326) Copyright Avail: NTIS HC/MF A05

Fatigue is a potential failure mode of submarine pressure hulls. Australia's new Type 471 submarines will be constructed from a new high strength steel. The higher design loadings made possible by the higher strength make fatigue an even more significant consideration than in other designs. The stress analysis of submarine pressure hulls under hydrostatic loading is reviewed. The main emphasis is on analytical methods of calculation of the fatigue loading rather than the calculation of buckling pressure. Because of the emphasis on fatigue, stress concentrations, residual stresses, and the interaction between residual and applied stresses are considered. Author

N91-18451# IntelliSys Corp., Albuquerque, NM.
DEVELOPMENT OF A HIGH-IMAGING SPEED SEM FOR DYNAMICALLY LOADED MATERIALS Final Report, Oct. 1988 - Oct. 1990
B. H. Fishbine, R. J. Macy, T. J. Ross, and M. L. Wang (New Mexico Univ., Albuquerque.) 31 Oct. 1990 60 p
(Contract F49620-89-C-0013; AF Proj. 3005)
(AD-A229244; AFOSR-90-1144TR) Avail: NTIS HC/MF A04 CSCL 09/5

The concept of using a high speed scanning electron microscope (SEM) observer real time microstructural response of dynamically loaded structural materials was verified experimentally at a maximum framing rate of 381 Hz (256 horizontal pixels x 128 vertical pixels), about order of magnitude higher than previously possible with conventional SEM's. This experiment accomplishment proved the soundness of several key concepts: (1) that a tungsten hairpin cathode is bright enough to obtain useful digital images at the framing rate listed above; (2) that a secondary electronic detector can be built and operated at high enough count rates to obtain such images; (3) that the scan coil assembly standard on an ISI SX-40A SEM can be replaced to allow imaging at such rates with spat resolution approaching 100 nm; (4) that signal acquisition and scan generation can be synchronized to obtain a succession of well defined frames in a movie format at pixel rates far in excess of convention TV-rate SEM video bandwidths; and (5) that a magnetically induced stress wave device can be used to obtain dynamic fracture within the SEM chamber and field of view, with scanning timed to coincide with fracture. Also documented herein are unanticipated results. GRA

N91-18452*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF TENSILE MEAN STRESS ON FATIGUE BEHAVIOR OF SINGLE-CRYSTAL AND DIRECTIONALLY SOLIDIFIED SUPERALLOYS
Sreeramesh Kalluri (Sverdrup Technology, Inc., Brook Park, OH.) and Michael A. McGaw 1990 17 p Presented at the Symposium on Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials, San Antonio, TX, 12-13 Nov. 1990; sponsored by American Society for Testing and Materials
(NASA-TM-103644; E-5827; NAS 1.15:103644) Avail: NTIS HC/MF A03 CSCL 20K

Two nickel base superalloys, single crystal PWA 1480 and directionally solidified MAR-M 246 + Hf, were studied in view of the potential usage of the former and usage of the latter as blade materials for the turbomachinery of the space shuttle main engine. The baseline zero mean stress (ZMS) fatigue life (FL) behavior of these superalloys was established, and then the effect of tensile mean stress (TMS) on their FL behavior was characterized. At room temperature these superalloys have lower ductilities and higher strengths than most polycrystalline engineering alloys. The cycle stress-strain response was thus nominally elastic in most of the fatigue tests. Therefore, a stress range based FL prediction approach was used to characterize both the ZMS and TMS fatigue data. In the past, several researchers have developed methods to account for the detrimental effect of tensile mean stress on the FL for polycrystalline engineering alloys. However, the applicability of these methods to single crystal and directionally solidified superalloys has not been established. In this study, these methods were applied to characterize the TMS fatigue data of single crystal PWA 1480 and directionally solidified MAR-M 246 + Hf and were found to be unsatisfactory. Therefore, a method of accounting for the TMS effect on FL, that is based on a technique proposed by Heidmann and Manson was developed to characterize the TMS fatigue data of these superalloys. Details of this method and its relationship to the conventionally used mean stress methods in FL prediction are discussed. Author

N91-18453# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
CRACK GROWTH BEHAVIOR OF ENCAPSULATION PROCESSED SiC-PMMA PARTICULATE COMPOSITES Ph.D. Thesis

Chi Hsien Sheu May 1990 75 p Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE91-005372; LBL-29611) Avail: NTIS HC/MF A04

The effect of processing on the fatigue crack propagation and fracture toughness of ceramic-polymer composites was investigated. A new process for composite production was developed with homogeneous particle distribution and low residual stress levels in mind. PMMA was uniformly distributed by encapsulating the SiC substrate by means of precipitation polymerization. The encapsulation processed powders were then compacted at temperatures above T(sub g) to form the composite. The encapsulation process was optimized by varying the initial concentrations of the reactants until homogeneous nucleation was suppressed. The coatings were found to be continuous at the SiC-PMMA interface, with particle agglomeration occurring between coated particles. Polymer loadings equivalent to 30 vol percent SiC were achieved. Composites of several particle size ranges were tested under cyclic fatigue and static loading conditions. Fatigue growth rates and fracture toughness data display a trend of increasing crack growth resistance with increasing particle size, with encapsulation processed composites outperforming conventionally cast composites in both cyclic fatigue and fracture resistance. The largest K(sub Ic) value was found to be 2.95 MPa(m)(sup 1/2), a factor of 3 increase over un-reinforced PMMA. The roles of crack deflection, shielding, bridging, and pinning in enhancing toughness were discussed in light of crack profile fracture surface details. DOE

N91-18454# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
VIBRATION CHARACTERISTICS OF ROTOR CONTAINING BOILING COOLANT
A. Yasuo, K. Kawamura, and F. Inada May 1990 23 p In JAPANESE; ENGLISH summary
(DE91-742145; CRIE-T-89040) Avail: NTIS HC/MF A03

This paper evaluated vibration characteristics of rotor containing boiling coolant. Experiments were conducted by air injecting to simulate the bubble generation in the rotor and by practically boiling coolant through electrical heating with a heater. Vibration level increased slightly at low rotor speeds (400 to 800 rpm) when boiling existed but the vibration stabilized with the increase of rotor speeds. Since the steam-water system and air-water system did not any difference, it was found that the phenomenon can be simulated by the air system. The liquid surface turbulence by boiling generated but was not synchronized with the rotor wheel motion at both lower and higher number of revolution than resonance point, and unstable excess vibration was not generated. When bubbles existed, unstable vibration appeared at a range of number of revolution. Since the estimated values and experimental values resulting unstable vibration agreed, unstable vibration at bubble generation can cope with by calculating unstable range and by separating the unstable rotating condition from a operation with some tolerance. DOE

N91-18455*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE LANGLEY RESEARCH CENTER CSI PHASE-0 EVOLUTIONARY MODEL TESTBED-DESIGN AND EXPERIMENTAL RESULTS
W. K. Belvin, Lucas G. Horta, and K. B. Elliott Jan. 1991 21 p Presented at the 4th NASA/DOD CSI Conference, Orlando, FL, 5-7 Nov. 1990
(NASA-TM-102762; NAS 1.15:102762) Avail: NTIS HC/MF A03 CSCL 20K

A testbed for the development of Controls Structures Interaction (CSI) technology is described. The design philosophy, capabilities, and early experimental results are presented to introduce some of the ongoing CSI research at NASA-Langley. The testbed, referred to as the Phase 0 version of the CSI Evolutionary model (CEM), is the first stage of model complexity designed to show the benefits of CSI technology and to identify weaknesses in current capabilities. Early closed loop test results have shown non-model based controllers can provide an order of magnitude increase in damping in the first few flexible vibration modes. Model based controllers for higher performance will need to be robust to model uncertainty as verified by System ID tests. Data are presented that show finite element model predictions of frequency differ from those obtained from tests. Plans are also presented for evolution of the CEM to study integrated controller and structure design as well as multiple payload dynamics. Author

N91-18456*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A VELOCITY COMMAND STEPPER MOTOR FOR CSI APPLICATION
Jeffrey L. Sulla (Lockheed Engineering and Sciences Co., Hampton, VA.), Jer-Nan Juang, and Lucas G. Horta Jan. 1991 19 p Presented at the 4th NASA/DOD CSI Conference, Orlando, FL, 5-7 Nov. 1990
(NASA-TM-102765; NAS 1.15:102765) Avail: NTIS HC/MF A03 CSCL 20K

The application of linear force actuators for vibration suppression of flexible structures has received much attention in recent years. A linear force actuator consists of a movable mass that is restrained such that its motion is linear. By application of a force to the mass, an equal and opposite reaction force can be applied to a structure. The use of an industrial linear stepper motor as a reaction mass actuator is described. With the linear stepper motor mounted on a simple test beam and the NASA Mini-Mast, output feedback of acceleration or displacement are used to augment the structural damping of the test articles. Significant increases in damping were obtained for both the test beam and the Mini-Mast. Author

N91-18457# Technische Univ., Berlin (Germany, F.R.). Physikalische Ingenieurwissenschaft.
CONSEQUENCES OF FRICTION IN LENGTH COMPENSATION FOR PROPELLER SHAFTS WITH BENDING VIBRATIONS AND BEARING FORCES Ph.D. Thesis [ANSWIRKUNGEN DER REIBUNG IM LAENGENAUSGLEICH VON GELENKWELLEN AUF BIEGESCWINGUNDEN UND LAGERKRAEFT]
Aly El-Kafrawy 1989 232 p In GERMAN
(ETN-91-98783) Avail: NTIS HC/MF A11

The computerized examination of the consequences of friction in length compensation of propeller shafts showed that an influence of bending vibration behavior of propeller shafts is given. It is also acting on the dynamic loading of the propeller shaft itself, the piping, and the welding connections. It also has a notable effect on the trunnion loading. It is of importance to reduce to a minimum the oscillations and the additional loads of the main bearing and of the trunnion, on account of friction in length compensation. Great attention should be given to the machining and the lubrication, in order to reduce the frictional force. ESA

N91-18458# Technische Univ., Brunswick (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik.
SHEAR FRACTURE OF ALUMINUM MAGNESIUM ALLOYS FOLLOWING LOCAL PLASTIC INSTABILITY Ph.D. Thesis [SCHERBRUCH IN ALUMINIUM - MAGNESIUM - LEGIERUNGEN INFOLGE LOKALER PLASTISCHER INSTABILITAET]
Manfred Heiser 1990 201 p In GERMAN Sponsored by DFG
(ETN-91-98788) Avail: NTIS HC/MF A10

The fracture forms of aluminum alloys tensile test specimens containing from 3 to 10 mass percentage magnesium were examined in relation to stress parameters of ductibility and temperature, and in relation to alloy content, degree of purity, and metal condition. It was shown, that shear fracture could occur near the Kegel Tasse fracture, as a conventional form of a ductable forced rupture. The comparison of the theoretical strain velocity with the shear zone velocity, as measured directly for each alloy in a wide test series allowed the model representation to be verified. There was good agreement between the theoretical strain velocity and the directly measured shear zone velocities. There was also

good agreement for the aluminum magnesium alloys, the description of the instability process, and the shear fracture introduction. ESA

N91-18459# Pacific Northwest Lab., Richland, WA.
MATERIALS PROPERTY MEASUREMENTS
D. M. Boyd, E. R. Green, S. R. Doctor, and M. S. Good 19 Apr. 1990 34 p
(Contract DE-AC06-76RL-01830)
(DE91-005612; PNL-SA-18163) Avail: NTIS HC/MF A03

An in-depth review of the measurement techniques that could be used in materials characterization is presented. The measurement techniques to non-destructively determine the in-service or time-related aging of materials considered include ultrasonic velocity and attenuation, eddy current conductivity, neutron scattering and absorption, conventional and tomographic imaging for ultrasonic and radiation imaging, x ray scattering, thermal impedance, and magnetic hysteresis. The three sections of the report include a review of failure mechanisms in steel and a discussion of nondestructive evaluation techniques and fracture mechanics, a description of a chart on Measurement Techniques versus Material Properties, and recommendations on the techniques and tests to be performed for the experimental investigations and analysis task of the project. DOE

N91-18460# Lawrence Livermore National Lab., CA.
AMBIENT TEMPERATURE FRACTURE STRENGTH OF PURE ALUMINA
G. A. Henshall and N. Q. Nguyen 19 Dec. 1990 17 p
(Contract W-7405-eng-48)
(DE91-007628; UCRL-ID-105842) Avail: NTIS HC/MF A03

The fracture of alumina copper-vapor laser tubes has led to great interest in the mechanical properties of pure alumina in the Copper Laser Program. In particular, knowledge of the fracture strength of the alumina used to make these tubes is required at temperatures ranging from ambient to 1500 C. The purpose of the work reported here was to confirm that the fracture strength data reasonably well describe the behavior of the alumina used in the Copper Laser Program. The goal was to make this investigation with the minimum of effort and cost. To this end, only ambient temperature tests were planned. DOE

N91-18016# Wichita State Univ., KS. Dept. of Mechanical Engineering.
ANALYSIS OF RESIDUAL STRESS IN PLASTIC-MEDIA-BLASTED THIN ALUMINUM SKIN BY X-RAY DOUBLE CRYSTAL DIFFRACTOMETRY Abstract Only
J. Chaudhuri, Y. M. Tan, and K. Patni (Cessna Aircraft Co., Wichita, KS.) *In its* Proceedings: Techfest 17 1991 p 15 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18017# Wichita State Univ., KS. Dept. of Mechanical Engineering.
EFFECTS OF INDUCED SURFACE SCRATCHES ON THE FATIGUE OF AERONAUTICAL MATERIALS Abstract Only
A. Inchekel and Jorge E. Talia *In its* Proceedings: Techfest 17 1991 p 16 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18981*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.
ESTABLISHMENT OF A STRAIN ANALYSIS CAPABILITY USING PHOTOELASTIC COATINGS
Samuel C. Gambrell, Jr. *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 2 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20K

N91-18988*# New Orleans Univ., LA. Dept. of Mechanical Engineering.
THEORETICAL HYPERVELOCITY BALLISTIC LIMIT FOR SINGLE OR DOUBLE PLATES USING NONLINEAR MODAL ANALYSIS
David Hui *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20K

42 GEOSCIENCES (GENERAL)

N91-18461# International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).
[ACTIVITIES REPORT OF THE INTERNATIONAL INSTITUTE FOR AEROSPACE SURVEY AND EARTH SCIENCES] Annual Report, 1989
1990 70 p
(ETN-91-98767) Copyright Avail: NTIS HC/MF A04

In 1989 the position of ITC (International Institute for Aerospace Survey and Earth Sciences) amongst the higher education in the Netherlands was consolidated, its financial status and subsidies were formalized, and research was formally recognized as one of its basic tasks, the focus being on the improvement of survey and environmental monitoring in support of planning and management. To this end, problem orientated multidisciplinary programs were established. The following areas or the Institute are followed: management, organization and personnel; the financial situation; the education (number of students and details of courses); postgraduate research projects and development; advisory services; and the capita selecta. ESA

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N91-18462# Pennsylvania State Univ., University Park. Dept. of Geosciences.
REMOTE SENSING AND HYDROLOGIC MODELING OF ARID WATERSHEDS: A SCALE ANALYSIS Final Report, 15 Jul. 1986 - 31 Aug. 1990
Thomas W. Gardner and Gary W. Petersen Aug. 1990 13 p
(Contract DE-FG02-86ER-60472)
(DE91-004044; DOE/ER-60472/T1) Avail: NTIS HC/MF A03

The increasing availability of digital elevation data (DED) created from remotely sensed data has promoted the development of computer algorithms for the calculation of geomorphometric properties of the land surface. These include parameters that are tedious or impossible to do by hand, for example, stream properties by order and flow path mapping for every location within the drainage basin. Flow paths especially are critical for water routing in hydrologic models. These algorithms can be used to explore spatial trends in landscape properties as a function of rock type, climate or neotectonic environment. The DED can be readily linked with a geographic information system (GIS) which is used to parameterize a quasi-physically based surface runoff model. Various representations (Shreve orders) of the watershed are created by simplifying a stream network delineated from the DED. Different Shreve orders produce significantly different geomorphometrics that affect simulated runoff volumes. At one of the study sites, the DED are not of sufficient detail to allow stream network extraction. Therefore, classification of SPOT panchromatic data was used to delineate ephemeral, fluvial networks on this low-relief, arid basin.

A one pixel proximity search classified correctly over 80 percent of the channelized flow. DOE

N91-18463# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
REACTIVE CHEMICAL TRANSPORT IN GROUND-WATER HYDROLOGY: CHALLENGES TO MATHEMATICAL MODELING
T. N. Narasimhan and J. A. Apps Jul. 1990 11 p Presented at the USA/USSR Joint Conference on Global Environmental Hydrology and Hydrogeology, Leningrad, USSR, 18-21 Jun. 1990
(Contract DE-AC03-76SF-00098)
(DE91-005244; LBL-29492; CONF-900629-2) Avail: NTIS HC/MF A03

For a long time, earth scientists have qualitatively recognized that mineral assemblages in soils and rocks conform to established principles of chemistry. In the early 1960's geochemists began systematizing this knowledge by developing quantitative thermodynamic models based on equilibrium considerations. These models have since been coupled with advective-dispersive-diffusive transport models, already developed by ground-water hydrologists. Spurred by a need for handling difficult environmental issues related to ground-water contamination, these models are being improved, refined and applied to realistic problems of interest. There is little doubt that these models will play an important role in solving important problems of engineering as well as science over the coming years. Even as these models are being used practically, there is scope for their improvement and many challenges lie ahead. In addition to improving the conceptual basis of the governing equations, much remains to be done to incorporate kinetic processes and biological mediation into extant chemical equilibrium models. Much also remains to be learned about the limits to which model predictability can be reasonably taken. The purpose of this paper is to broadly assess the current status of knowledge in modeling reactive chemical transport and to identify the challenges that lie ahead. DOE

N91-18464# Beleidscommissie Remote Sensing, Delft (Netherlands).
DETECTION OF SUBMARINE SPRINGS BY THERMAL INFRARED IMAGING Summary Report
Jul. 1990 30 p Prepared in cooperation with Bongaerts, Kuyper and Huiswaard, The Hague, Netherlands and Environmental Analysis and Remote Sensing, Delft, Netherlands
(BCRS-90-11; ETN-91-98467) Avail: NTIS HC/MF A03

Generally there is a temperature difference between the spring water and that of the sea into which it discharges. Provided the temperature difference is sufficiently large and the discharge is concentrated, detection is possible using thermal infrared imaging. This technique enables whole stretches of coastline to be surveyed quickly and field measurements can then be restricted to the most promising areas thus saving time and money. Research carried out to demonstrate the usefulness of developing countries with low cost technology using a microlight aircraft as the platform for the infrared instrumentation, is described. ESA

N91-18465# Winand Staring Centre, Wageningen (Netherlands).
DIGITAL ANALYSIS OF SATELLITE DATA AND NUMERICAL SIMULATION APPLIED TO IRRIGATION WATER MANAGEMENT BY MEANS OF A DATABASE SYSTEM
T. N. M. Visser, M. Menenti, J. A. Morabito, and A. Drovandi (Universidad de Mendoza, Argentina) 1989 17 p Presented at the International Conference on use of Computers in Scientific and Technical Research, Mendoza, Argentina, 24-29 Apr. 1989
(REPT-4; ISSN-0924-3062; ETN-91-98471) Copyright Avail: NTIS HC/MF A03

A procedure to combine computational applications, involving several software/hardware configurations, to calculate and map three irrigation performance indices is described. The software hardware configuration fulfills five basic functions: digital image processing; handling of vector data (maps); hydrological calculations; numerical simulation; solution of optimization problems. Each component of the procedure is detailed. An example of application, dealing with the Rio Tunuyan (Argentina) irrigation scheme is presented. The entire procedure could be developed into a personal computer based software package. ESA

N91-18466*# Purdue Univ., West Lafayette, IN. Graduate School.
DETERMINING CROP RESIDUE TYPE AND CLASS USING SATELLITE ACQUIRED DATA M.S. Thesis Progress Report, Jun. 1990
Xin Zhuang 1990 144 p
(Grant NAGw-1472)
(NASA-CR-187632; NAS 1.26:187632) Avail: NTIS HC/MF A07 CSCL 08B

LANDSAT Thematic Mapper (TM) data for March 23, 1987 with accompanying ground truth data for the study area in Miami County, IN were used to determine crop residue type and class. Principle components and spectral ratioing transformations were applied to the LANDSAT TM data. One graphic information system (GIS) layer of land ownership was added to each original image as the eighth band of data in an attempt to improve classification. Maximum likelihood, minimum distance, and neural networks were used to classify the original, transformed, and GIS-enhanced remotely sensed data. Crop residues could be separated from one another and from bare soil and other biomass. Two types of crop residue and four classes were identified from each LANDSAT TM image. The maximum likelihood classifier performed the best classification for each original image without need of any transformation. The neural network classifier was able to improve the classification by incorporating a GIS-layer of land ownership as an eighth band of data. The maximum likelihood classifier was unable to consider this eighth band of data and thus, its results could not be improved by its consideration. Author

N91-18467 Politecnico di Milano (Italy). Dipt. di Elettronica.
LIMITS TO THE RESOLUTION OF ELEVATION MAPS FROM STEREO SAR IMAGES
C. Prati (Consiglio Nazionale delle Ricerche, Milan, Italy) and F. Rocca 1990 33 p Previously announced in IAA as A91-20342 Sponsored by the Stanford Exploration Project, CNR, and Italian Ministry of Public Education
(REPT-90-035; ETN-91-98647) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The limits to the resolution of elevation maps from SAR (Synthetic Aperture Radar) interferometry are approximately analyzed from theoretical and experimental points of view. Examples of interference fringes obtained from SEASAT SAR images of the Panamint Valley are presented and exploited as test images. The distance between the orbits normal to the slant range was calculated. It is observed that the coherence between the images is obtained only if the satellites are within the beam of the ground antenna generated by the ground resolution cell, whose width depends on the terrain slope in the range direction. The altitude resolution is shown to depend on speckle and additive noise. ESA

N91-18468# Winand Staring Centre, Wageningen (Netherlands).
HIGH AND LOW RESOLUTION SATELLITE IMAGES TO MONITOR AGRICULTURAL LAND
Susanna Azzani 1990 82 p Sponsored by Beleidscomissie Remote Sensing, Delft, Netherlands
(REPT-18; ISSN-0924-3062; ETN-91-98777) Copyright Avail: NTIS HC/MF A05

The evaluation of feasible methods to improve the real time information on agricultural production, an aspect of the monitoring agro-ecological resources by means of remote sensing and simulation (MARS) project in Zambia, is presented. The use of remote sensing images together with geographical information system and implementation of numerical simulation model based on crop growth (WOFOST) were used to develop such methods. The combination of different indirect measurements such as satellite data (LANDSAT Thematic Mapper and multispectral scanner, NOAA-AVHR-NDVI), aerial photographs, meteorological data, literature information, and maps has shown a synergistic

effect to understand the considered agricultural scenarios. Remarkable results were obtained to assess agricultural production by means of NOAA-AVHRR-NDVI data. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N91-18469# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
SOLID OXIDE FUEL CELLS: A NEW CATHODE MATERIAL (La, Sr)(Mn, Cr)O FOR SOFC
M. Mori and C. Asakawa Apr. 1990 32 p In JAPANESE; ENGLISH summary
(DE91-736731; CRIE-W-89032) Avail: NTIS HC/MF A03

As the electro motive force of the single cell of a solid oxide fuel cell (SOFC) is about 1V, it is necessary to stack single cells and raise the voltage. The problems are pointed out of lanthanum manganite, which is used for an air electrode to produce cell stacks and to operate cells for a long time, and introduces a measure to solve the problems. The cause for the deterioration of the cell capacity is considered as follows. By the heating treatment of lanthanum manganite, the electrode particles are sintered minutely and that causes the fall of the gas diffusion function and the formation of a side reactant of high electrical resistance on the interface of the electrode and the zirconia electrolyte. Mn of lanthanum manganite was, therefore, displaced by Cr. As a result, the chemical stability with zirconia was increased and a compound of high electrical resistance was hardly formed. The degree of sintering was decreased and the deterioration of the electrode characteristics was reduced. A new electrode which has high chemical stability even after high temperature treatment was thus found out. DOE

N91-18470# Sandia National Labs., Albuquerque, NM. Solar Thermal Collector Technology.
ADVANCED SOLAR CONCENTRATOR DEVELOPMENT IN THE UNITED STATES
Daniel J. Alpert 1990 18 p Presented at the Seminar on Solar Power Systems, Yalta, USSR, 22-26 Apr. 1990
(Contract DE-AC04-76DP-00789)
(DE91-005143; SAND-90-2490C; CONF-9004267-1) Avail: NTIS HC/MF A03

Sandia National Laboratories is the lead laboratory for the United States Department of Energy's program to develop, build, and test advanced solar concentrators that are low in cost, have high performance, and demonstrate a long lifetime. The principal focus of DOE's concentrator program is on the development of heliostats for central receiver power plants and point focus parabolic dishes for use with a 25-kWe Stirling engine. The status and future plans of DOE's program in each area are reviewed. DOE

N91-18471# Adiabatics, Inc., Columbus, IN.
UNCOOLED TWO-STROKE GAS ENGINE FOR HEAT PUMP DRIVE
Patrick Badgley, Dave McNulty, and Melvin Woods 1990 24 p Presented at the Society of Automotive Engineers (SAE) Annual Meeting, Detroit, MI, 15 Dec. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005482; CONF-901261-1) Avail: NTIS HC/MF A03

This paper describes the design and analysis of a family of natural gas fueled, uncooled, two-stroke, lean burn, thermal-ignition engines. The engines were designed specifically to meet the requirements dictated by the commercial heat pump application. The engines have a power output ranging from 15 to 100 kW; a thermal efficiency of 36 percent; a mean time between failure greater than 3 years; and a life expectancy of 45,000 hours. To meet these specifications a family of very simple, uncooled, two-stroke cycle engines were designed which have no belts, gears or pumps. The engines utilize crankcase scavenging, lubrication, stratified fuel introduction to prevent raw fuel from escaping with the exhaust gas, and use of ceramic rolling contact bearings. The Thermal Ignition Combustion System (TICS) is used for ignition to enable the engines to operate with a lean mixture and eliminate spark plug erosion. DOE

N91-18472# Oak Ridge National Lab., TN.
THERMAL ENERGY STORAGE TECHNOLOGIES FOR HEATING AND COOLING APPLICATIONS
John J. Tomlinson 19 Dec. 1990 10 p
(Contract DE-AC05-84OR-21400)
(DE91-005609; ORNL/FTR-3844) Avail: NTIS HC/MF A02

Recent results from selected thermal energy storage (TES) research activities in Germany and Sweden are discussed. In addition, several new technologies for heating and cooling of buildings and automobiles were reviewed and found to benefit similar efforts in the United states. Details of a meeting with Didier-Werke AG, a leading German ceramics manufacturer who will provide TES media necessary for the United States to complete field tests of an advanced high temperature latent heat storage material, are presented. Finally, an overview of the December 1990 International Energy Agency (IEA) Executive Committee deliberations on TES is presented. DOE

N91-18473# Midwest Research Inst., Golden, CO.
CONSERVATION AND RENEWABLE ENERGY TECHNOLOGIES FOR TRANSPORTATION
Nov. 1990 20 p
(Contract DE-AC02-83CH-10093)
(DE91-002103; DOE/CH-10093/84) Avail: NTIS HC/MF A03

The Office of Transportation Technologies (OTT) is charged with long-term, high-risk, and potentially high-payoff research and development of promising transportation technologies that are unlikely to be undertaken by the private sector alone. OTT activities are designed to develop an advanced technology base within the U.S. transportation industry for future manufacture of more energy-efficient, fuel-flexible, and environmentally sound transportation systems. OTT operations are focused on three areas: advanced automotive propulsion systems including gas turbines, low heat rejection diesel, and electric vehicle technologies; advanced materials development and tribology research; and research, development, demonstration, test, and evaluation (including field testing in fleet operations) of alternative fuels. Five papers describing the transportation technologies program have been indexed separately for inclusion on the data base. DOE

N91-18474# Siemens Solar Industries, Camarillo, CA.
RESEARCH ON STABLE, HIGH-EFFICIENCY, LARGE-AREA AMORPHOUS SILICON BASED MODULES, TASK B Final Subcontract Report, 1 Mar. 1989 - 28 Feb. 1990
K. W. Mitchell and D. R. Willet Oct. 1990 30 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE91-002115; SERI/TP-211-3967) Avail: NTIS HC/MF A03

Progress in the development of a stable, high efficiency, four terminal hybrid tandem module is documented. The module consists of a semi-transparent, thin film silicon:hydrogen alloy (TFS) top circuit and a copper indium diselenide (CuInSe2) bottom circuit. Film deposition and patterning processes were successfully extended to 0.4 sq m substrates. A 33.2 W (8.4 percent efficient) module with a 3970 sq cm aperture area and a white back reflector was demonstrated; without the back reflector, the module produced 30.2 W (7.6 percent efficient). Placing a laminated, 31.6 W, 8.1 percent efficient CuInSe2 module underneath this TFS module, with an air gap between the two, produces 11.2 W (2.9 percent efficient) over a 3883 sq cm aperture area. Therefore, the four terminal tandem power output is 41.4 W, translating to a 10.5 percent aperture-area efficiency. Subsequently, a 37.8 W (9.7

percent aperture-area efficiency) CuInSe2 module was demonstrated with a 3905 sq cm aperture area. Future performances of single junction and tandem modules of this size were modeled, and predicted power outputs exceed 50 W (13 percent efficient) for CuInSe2 and 65 W (17 percent efficient) for TFS/CuInSe2 tandem modules. DOE

N91-18475# Sandia National Labs., Albuquerque, NM.
SOLAR REFORMING OF METHANE IN A DIRECT ABSORPTION CATALYTIC REACTOR ON A PARABOLIC DISH. 2: MODELING AND ANALYSIS
Russell D. Skocypec, Roy E. Hogan, Jr., and James F. Muir 1991 28 p Presented at the 13th ASME-JSME International Solar Energy Conference, Reno, NV, 17-22 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-005859; SAND-90-2946C; CONF-910318-14) Avail: NTIS HC/MF A03

The catalytically enhanced solar absorption receiver (CAESAR) experiment was conducted to determine the thermal, chemical, and mechanical performance of a commercial-scale, dish-mounted, direct catalytic absorption receiver (DCAR) reactor over a range of steady state and transient (cloud) operating conditions. The focus of the experiment is on global performance such as receiver efficiencies and overall methane conversion; it was not intended to provide data for code validation. A numerical model was previously developed to provide guidance in the design of the absorber. The one-dimensional, planar and steady-state model incorporates, the following energy transfer mechanisms: solar and infrared radiation, heterogeneous chemical reaction, conduction in the solid phase, and convection between the fluid and solid phases. A number of upgrades to the model and improved property values are presented here. Model predictions are shown to bound the experimental axial thermocouple data when experimental uncertainties are included. Global predictions are made using a technique in which the incident solar flux distribution is subdivided into flux contour bands. Model predictions for each band are then spatially integrated to provide global predictions such as reactor efficiencies and methane conversions. Global predictions are shown to compare well with experimental data. Reactor predictions for anticipated operating conditions suggest a further decrease in optical density at the front of the absorber inner disk may be beneficial. The need to conduct code-validation experiments is identified as being essential in improving the confidence in the capability to predict large-scale reactor operation. DOE

N91-18476# Midwest Research Inst., Golden, CO.
SOLAR REFLECTOR SOILING PATTERN DISTRIBUTIONS AND REFLECTANCE MEASUREMENT REQUIREMENTS
Kevin Kidney (Colorado Univ., Denver.) Oct. 1990 33 p
(Contract DE-AC02-83CH-10093)
(DE89-009431; SERI/TP-255-3369) Avail: NTIS HC/MF A03

Short-term specular reflectance losses from optical surfaces used in the collection or concentration of solar energy results in significant reduction of these systems' output. Losses range from 0.1 to 1.0 percent per day, approaching asymptotes of 25 to 60 percent for periods greater than one year, depending on site and season. To appropriately assess the value of a particular location for the production of power, consideration of the rates of soiling and strategies to minimize losses resulting from soiling must be considered. Strategies for measuring the optical performance of reflector materials to a specified degree of accuracy have been developed, according to the types of soiling patterns observed. It was found that most soiling occurs with the accumulation of particulates in spots of different sizes, and the spot sizes follow a lognormal distribution. For most practical situations, it was determined that 10 measurements with a 1-cm-diameter beam are enough to place the average value within 3 percent of the true value, with a confidence level of 95 percent. DOE

N91-18477# Midwest Research Inst., Golden, CO.
AMORPHOUS SILICON RESEARCH PROJECT GOVERNMENT/INDUSTRY PROGRAM Summary Report, 1987 - 1989
Werner Luft and Byron Stafford Sep. 1990 49 p
(Contract DE-AC02-83CH-10093)
(DE90-000376; SERI/TP-211-3933) Avail: NTIS HC/MF A03

This summary report covers that the second DOE/SERI three-year amorphous silicon initiative (1987 to 1989). Increased performance of amorphous silicon cells has resulted as a result of progress in the areas of light (photon) management and device structure. An improved utilization of the solar spectrum has resulted from developing textured transparent conducting oxide contacts and multilayer back reflectors, which have enhanced the light trapping in cells. For example, researchers developed a high-conductivity, textured SnO2:F front contact deposited by atmospheric-pressure chemical vapor deposition on glass; the sheet resistance is low (8 to 10 Omega/square) and the optical transmittance is high (over 80 percent over the wavelength range 450 to 700 nm). Subsequently, researchers developed a textured ZnO front contact with an optical transmittance over a wider range than that of SnO2:F. Reactors also developed highly reflective indium tin oxide (ITO)/aluminum and ZnO/Al or ZnO/Ag multilayer back reflectors that result in enhanced quantum efficiencies for a-SiGe:H(F) of up to 67 percent at 700 nm. Notable efficiencies were achieved for all-amorphous-silicon alloy, two-terminal, different-band-gap multijunction devices. Efficiencies for two-terminal, same-band-gap, multijunction 0.25-sq cm cells and 900-sq cm submodules were also improved, as were the efficiencies for four-terminal, 4-sq cm cells and 900-sq cm submodules. DOE

N91-18478# Carnegie-Mellon Univ., Pittsburgh, PA.
IMPROVEMENT OF BULK AND EPITAXIAL III-V SEMICONDUCTORS FOR SOLAR CELLS BY CREATION OF DENUDED RECOMBINATION ZONES Final Subcontract Report, 1 Sep. 1986 - 30 Jun. 1990
D. Wong, H. K. Kim, A.-Z. Li, T. E. Schlesinger, and A. G. Milnes Nov. 1990 140 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE90-000387; SERI/TP-211-3990) Avail: NTIS HC/MF A07

Increases in hole diffusion lengths of up to a factor of three were obtained in commercially grown liquid encapsulated Czochralski (Te-doped) and Si-doped horizontal Bridgman GaAs. This was achieved by application of a technique involving proximity annealing of the material in sealed silica ampoules. The short wavelength photoresponse of the cells was also enhanced. This was achieved by passivation of the surfaces of the cells with a simple chemical treatment using ammonium sulphide. Defect studies with deep level transient spectroscopy and photo-luminescence revealed that the dominant recombination center in the material studied is a hole trap we have termed HCX (E(sub v)+0.29 eV). This is believed to be a native defect, perhaps associated with excess arsenic. Defect suppression was achieved in molecular beam epitaxial films by isoelectronic doping (with In and Sb). It was also shown that the defect structure in the films was affected by the choice of growth parameters such as growth rate and temperature. DOE

N91-18479# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC ADVANCED RESEARCH AND DEVELOPMENT PROJECT: SOLAR RADIATION RESEARCH Annual Report, 1 Oct. 1989 - 30 Sep. 1990
C. J. Riordan, Robert L. Hulstrom, T. Cannon, D. R. Myers, and T. Stoffel Nov. 1990 25 p Presented at the 10th Review Meeting of the SERI Photovoltaic Advanced Research and Development Project, Oct. 1990 Submitted for publication
(Contract DE-AC02-83CH-10093)
(DE91-002119; SERI/TP-215-4063) Avail: NTIS HC/MF A03

An overview is given of the fiscal year 1990 research activities and results under the Solar Radiation Research Task of the Photovoltaic Advanced Research and Development Project at the Solar Energy Research Institute. The activities under this task include developing and applying measurement techniques, instrumentation, and data and models to understand and quantify

the response of photovoltaic devices to variations in broadband and spectra solar radiation. DOE

N91-18480# Argonne National Lab., IL.
ENERGY-EFFICIENCY COMPARISON OF ADVANCED AMMONIA HEAT-EXCHANGER TYPES
C. Panchal and T. Rabas 1990 42 p Presented at the 13th International Institute of Ammonia Refrigeration Annual Meeting, San Francisco, CA, 24-27 Mar. 1991
(Contract W-31-109-eng-38)
(DE91-006470; CONF-9103107-1) Avail: NTIS HC/MF A03

Ammonia is the most cost-effective working fluid for many Rankine power cycles and is widely utilized in industrial refrigeration applications. For example, it was selected as the most advantageous working fluid for the comprehensive closed-cycle Ocean Thermal Energy Conversion investigations where the heat source and sink are the warm, surface seawater and the cold, deep seawater, respectively. An essential part of this investigation was to measure the performance of many advanced heat-exchanger types using ammonia as the working fluid and to compare these results with those for conventional shell-and-tube designs. This paper presents an overview of these experiments and their potential significance for improved energy efficiency for industrial refrigeration applications. The heat exchangers used for industrial refrigeration systems account for about 50 percent of the equipment cost. However, current practice is to use state-of-the-art designs -- the shell-and-tube type without enhanced tubes. Substantial energy savings are possible through the use of advanced ammonia evaporator and condenser heat-exchanger types. DOE

N91-18481# Stanford Univ., CA. Solid State Electronics Lab.
HIGH-EFFICIENCY CONCENTRATOR SILICON SOLAR CELLS
R. A. Sinton, A. Cuevas, R. R. King, and R. M. Swanson Nov. 1990 149 p
(Contracts DE-AC04-76DP-00789; SNL-75-6318)
(DE91-006754; SAND-90-7033) Avail: NTIS HC/MF A07

This report presents results from extensive process development in high-efficiency Si solar cells. An advanced design for a 1.56-cm(sup 2) cell with front grids achieved 26 percent efficiency at 90 suns. This is especially significant since this cell does not require a prismatic cover glass. New designs for simplified backside-contact solar cells were advanced from a status of near-nonfunctionality to demonstrated 21 to 22 percent for one-sun cells in sizes up to 37.5 cm(sup 2). An efficiency of 26 percent was achieved for similar 0.64-cm(sup 2) concentrator cells at 150 suns. More fundamental work on dopant-diffused regions is also presented here. The recombination vs. various process and physical parameters was studied in detail for boron and phosphorous diffusions. Emitter-design studies based solidly upon these new data indicate the performance vs. design parameters for a variety of the cases of most interest to solar cell designers. Extractions of p-type bandgap narrowing and the surface recombination for p- and n-type regions from these studies have a generality that extends beyond solar cells into basic device modeling. DOE

N91-18482# Oak Ridge National Lab., TN.
DEVELOPMENT OF COMPOSITE LATENT/SENSIBLE HEAT STORAGE MEDIA
R. Petri, E. T. Ong, and A. Kardas (Institute of Gas Technology, Chicago, IL.) Dec. 1990 141 p
(Contract DE-AC05-84OR-21400)
(DE91-005636; ORNL/SUB-86-95001/1) Avail: NTIS HC/MF A07

Results of an on-going program to develop a composite latent-sensible thermal energy storage medium, trade marked CompPhase, are presented. The target application area was periodic kiln energy recovery. The concept is that of a composite salt/ceramic material processed such that the medium maintains its shape and mechanical integrity through the salt melting temperature. As such, the media can be fabricated into a variety of shapes suitable for packed beds, fluidized beds, or direct contact heat exchangers. The properties of ten carbonate salt or eutectic mixtures of carbonate salts were reviewed to select the most appropriate candidates for development. Three salts and two ceramic materials were evaluated in laboratory tests to select the final material, a composite of sodium-barium eutectic/magnesium oxide, for development. Two methods of processing the constituent powders for fabrication into storage pellets were developed, and one method was applied to pellet fabrication by commercial processing equipment. Two different preliminary cost estimates bracketed the expected cost of commercially fabricating storage pellets. Also, two modifications to the material processing method were suggested to reduce costs. Thermal cycling was conducted on laboratory produced experimental pellets and on prototype pellets fabricated by commercial processes. Detailed laboratory tests to determine composite mechanical and thermal properties were conducted. It is concluded that further laboratory, field, and economic studies are required before the concept of composite storage media can be considered fully developed for commercialization. DOE

N91-18483# Texas A&M Univ., College Station. Center for Electrochemical Systems and Hydrogen Research.
OXYGEN ELECTRODE IN MOLTEN CARBONATE FUEL CELLS
B. B. Dave, R. E. White, S Srinivasan, and A. J. Appleby 1990 41 p
(Contract DE-FG22-87PC-79931)
(DE91-005743; DOE/PC-79931/T6) Avail: NTIS HC/MF A03

During this quarter, impedance data were analyzed for an oxygen reduction process in molten carbonate electrolyte and a manuscript, Impedance Analysis for Oxygen Reduction in a Lithium Carbonate Melt: Effects of Partial Pressure of Carbon Dioxide and Temperature, was prepared to be submitted to Journal of the Electrochemical Society for publication. DOE

N91-18484# Argonne National Lab., IL.
APPLICATION OF THE MONOLITHIC SOLID-OXIDE FUEL CELL TO SPACE POWER SYSTEMS
K. M. Myles and S. K. Bhattacharyya 1991 6 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991
(Contract W-31-109-eng-38)
(DE91-005833; CONF-910116-14) Avail: NTIS HC/MF A02

The monolithic solid-oxide fuel cell (MSOFC) has been under development at Argonne National Laboratory since 1983. The unique design of the MSOFC provides the promise of exceptionally high power and energy densities that can be particularly beneficial to space power systems. The MSOFC is an oxide ceramic structure in which appropriate electronic and ionic conductors are fabricated in a honeycomb shape similar to a block of corrugated paperboard. The electrolyte that conducts oxygen ions from the air side to the fuel side is yttria-stabilized zirconia (YSZ). All the other materials are electronic conductors, including the nickel-YSZ anode, the strontium-doped lanthanum manganite cathode, and the doped lanthanum chromite interconnect (bipolar plate). These electronic and ionic conductors are arranged to provide short conduction paths to minimize resistive losses. The power density achievable with the MSOFC is expected to be about 8 kW/kg or 4 kW/L at fuel efficiencies over 50 percent, because of small cell size and low resistive losses in the materials. These performances have been approached in laboratory test fuel cell stacks of nominal 125 W capacities. The MSOFC operates in the range 973K to 1273K, at which temperatures rapid reform of hydrocarbon fuels is expected with the nickel-YSZ fuel channels. DOE

N91-18485# Lawrence Livermore National Lab., CA.
THULIUM HEAT SOURCE IR/D PROJECT 91-031
C. E. Walter, J. E. Kammeraad, J. G. Newman, R. VanKonynenburg, and J. H. VanSant Jan. 1991 7 p
(Contract W-7405-eng-48)
(DE91-007117; UCRL-ID-106187) Avail: NTIS HC/MF A02

The goal of the thulium heat source study is to determine the performance capability and evaluate the safety and environmental aspects of a thulium-170 heat source. Thulium-170 has several attractive features, including the fact that it decays to a stable,

chemically innocuous isotope in a relatively short time. A longer-range goal is to attract government funding for the development, fabrication, and demonstration testing in an autonomous underwater vehicle (AUV) of one or more thulium isotope power (TIP) prototype systems. The approach is to study parametrically the performance of thulium-170 heat source designs in the power range of 5 to 50 kW(sub th). At least three heat source designs will be characterized in this power range to assess their performance, mass, and volume. The authors will determine shielding requirements, and consider the safety and environmental aspects of their use. DOE

N91-18157*# Washington Univ., Seattle.
MEGAWATT SOLAR POWER SYSTEMS FOR LUNAR SURFACE OPERATIONS
B. Adams, S. Alhadeff, S. Beard, D. Carlile, D. Cook, C. Douglas, D. Garcia, D. Gillespie, R. Golingo, and D. Gonzalez et al *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 229-239 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 10A

N91-19015*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
FREQUENCY RESPONSE OF ELECTROCHEMICAL CELLS
Daniel L. Thomas *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N91-18486# Pacific Northwest Lab., Richland, WA.
GREENHOUSE GASES: WHAT IS THEIR ROLE IN CLIMATE CHANGE
J. A. Edmonds, W. U. Chandler, and Donald J. Wuebbles (Lawrence Livermore National Lab., CA.) Dec. 1990 41 p Presented at the Dahlem Workshop on Limiting Greenhouse Effect: Options for Controlling Atmospheric CO2 Accumulation, Berlin, Fed. Republic of Germany, 9-14 Dec. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005447; PNL-SA-18815; CONF-901262-1) Avail: NTIS HC/MF A03

This paper summarizes information relevant to understanding the role of greenhouse gases in the atmosphere. It examines the nature of the greenhouse effect, the Earth's radiation budget, the concentrations of these gases in the atmosphere, how these concentrations have been changing, natural processes which regulate these concentrations of greenhouse gases, residence times of these gases in the atmosphere, and the rate of release of gases affecting atmospheric composition by human activities. We address the issue of the greenhouse effect itself in the first section. In the second section we examine trends in atmospheric concentration of greenhouse gases and emissions sources. In the third section, we examine the natural carbon cycle and its role in determining the atmospheric residence time of carbon dioxide (CO2). In the fourth section, we examine the role atmospheric chemistry plays in the determining the concentrations of greenhouse gases. This paper is not intended to be an exhaustive treatment of these issues. Exhaustive treatments can be found in other volumes, many of which are cited throughout this paper. Rather, this paper is intended to summarize some of the major findings, unknowns, and uncertainties associated with the current state of knowledge regarding the role of greenhouse gases in the atmosphere. DOE

N91-18487# Oak Ridge National Lab., TN.
THE OCEAN'S ROLE IN THE GLOBAL CARBON CYCLE Foreign Trip Report
L. Fortunat Joos 20 Dec. 1990 7 p
(Contract DE-AC05-84OR-21400)
(DE91-005985; ORNL/FTR-3847) Avail: NTIS HC/MF A02

The traveler collaborated with Dr. J. L. Sarmiento of the Program in Atmospheric Sciences, Princeton University, and Dr. U. Siegenthaler of the University of Bern in box-model studies of the potential enhancement of oceanic CO2 uptake by fertilizing the southern ocean with iron. As a result of this collaboration, a letter describing the results was submitted to the journal Nature. Sensitivity studies were carried out to gain a better understanding of the processes involved for a hypothetical iron fertilization of the ocean. An article that describes this work has been submitted to the journal Global Biogeochemical Cycles. The traveler and U. Siegenthaler are preparing a journal article describing a box model of the global carbon cycle that is an extension of the 1-D box-diffusion model. The traveler attended Oceanography 590b at the University of Washington in Friday Harbor. While at Friday Harbor, he started to collaborate with Drs. M. Warner, R. Gammon, and J. Bullister, all from the University of Washington, Seattle, to calibrate the global carbon cycle model with chlorofluorocarbon CFC-11 and CFC-12. The traveler started collaboration with Drs. J. C. Orr and J. L. Sarmiento to calculate apparent eddy diffusivities from the Princeton 3-D ocean model. DOE

N91-18488# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
DEVELOPMENT OF AN ATMOSPHERIC DIFFUSION EVALUATION METHOD INCORPORATING THERMAL AND TOPOGRAPHICAL EFFECTS, PART 3
Y. Ichikawa and K. Sada Apr. 1990 32 p In JAPANESE; ENGLISH summary
(DE91-736741; CRIE-T-89038) Avail: NTIS HC/MF A03

In mathematical models on the atmospheric diffusion of air pollutant, the problem on the application of a Lagrangian particle model was studied. Advantages of this model are as follows: Turbulent statistics governing diffusion are directly used for the model. The model involves little problem associated with numerical analysis. On the other hand, turbulence data which are difficult to predict or to observe are required for calculation. It is necessary to follow many particles to obtain satisfactory calculation results, and a lot of computer time is required. Sensitivity analyses were executed to examine the effect of turbulent quantities on diffusion calculation. The results of the analysis show that standard deviation of wind fluctuations greatly affects on diffusion calculation. The Kernel method where each particle is given density distribution at the calculation time, is useful to decrease the number of particles used for calculation. However it is necessary to use smaller values for the spread of particle density. DOE

N91-18489*# Atmospheric and Environmental Research, Inc., Cambridge, MA.
EFFECTS OF ENGINE EMISSIONS FROM HIGH-SPEED CIVIL TRANSPORT AIRCRAFT: A TWO-DIMENSIONAL MODELING STUDY, PART 1 Report, Jul. 1988 - Jun. 1989
Malcolm K. W. Ko, Debra K. Weisenstein, Nein Dak Sze, Jose M. Rodriguez, and Curtis Heisey Washington Mar. 1991 98 p Prepared for ST Systems Corp., Hampton, VA
(Contract NAS1-18460)
(NASA-CR-4346-PT-1; NAS 1.26:4346-PT-1) Avail: NTIS HC/MF A05 CSCL 13B

The AER two-dimensional chemistry-transport model is used to study the effect on stratospheric ozone (O3) from operations of supersonic and subsonic aircraft. The study is based on six emission scenarios provided to AER. The study showed that: (1) the O3 response is dominated by the portion of the emitted nitrogen compounds that is entrained in the stratosphere; (2) the entrainment is a sensitive function of the altitude at which the material is injected; (3) the O3 removal efficiency of the emitted material depends on the concentrations of trace gases in the background atmosphere; and (4) evaluation of the impact of fleet operations

in the future atmosphere must take into account the expected changes in trace gas concentrations from other activities. Areas for model improvements in future studies are also discussed.
Author

N91-18490*# Atmospheric and Environmental Research, Inc., Cambridge, MA.
EFFECTS OF ENGINE EMISSIONS FROM HIGH-SPEED CIVIL TRANSPORT AIRCRAFT: A TWO-DIMENSIONAL MODELING STUDY, PART 2 Report, Jul. - Dec. 1989
Malcolm K. W. Ko, Debra K. Weisenstein, Nein Dak Sze, Run-Lie Shia, Jose M. Rodriguez, and Curtis Heisey Washington Mar. 1991 66 p Prepared for ST Systems Corp., Hampton, VA
(Contract NAS1-18460)
(NASA-CR-4346-PT-2; NAS 1.26:4346-PT-2) Avail: NTIS HC/MF A04 CSCL 13B

The AER two-dimensional chemistry-transport model is used to study the effect of supersonic and subsonic aircraft operation in the 2010 atmosphere on stratospheric ozone (O3). The results show that: (1) the calculated O3 response is smaller in the 2010 atmosphere compared to previous calculations performed in the 1980 atmosphere; (2) with the emissions provided, the calculated decrease in O3 column is less than 1 percent; and (3) the effect of model grid resolution on O3 response is small provided that the physics is not modified.
Author

N91-18491# Deutscher Bundestag, Bonn (Germany, F.R.).
PROTECTING THE EARTH'S ATMOSPHERE: AN INTERNATIONAL CHALLENGE. REPORT OF THE STUDY COMMISSION OF THE 11TH GERMAN BUNDERSTAG PREVENTIVE MEASURES TO PROTECT THE EARTH'S ATMOSPHERE Interim Report
1989 594 p
(ISBN-3-924521-36-0; ETN-91-98510) Avail: NTIS HC/MF A25

A detailed account of current scientific knowledge about stratospheric ozone depletion and the greenhouse effect, and recommendations on far reaching measures to protect the Earth's atmosphere are presented. The problems involved in protecting tropical forests are highlighted. The avoidance and reduction of releases of radiatively active trace gases due to energy used are dealt with. The details regarding the recommendations for action at national level and the development of the political debate on these topics in the Federal Republic of Germany are given. ESA

N91-18492# Oak Ridge National Lab., TN.
INFORMATION TECHNOLOGY AND GLOBAL CHANGE SCIENCE
F. Paul Baxter 1990 10 p Presented at the Global Change: Economic Issues in Agriculture, Forestry, and Natural Resources, Washington, DC, 19-21 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005020; CONF-9011154-1) Avail: NTIS HC/MF A02

The goal of this paper is to identify and briefly describe major existing and near term information technologies that could have a positive impact on the topics being discussed at this conference by helping to manage the data of global change science and helping global change scientists conduct their research. Desktop computer systems have changed dramatically during the past seven years. Faster data processing can be expected in the future through full development of traditional serial computer architectures. Some other proven information technologies may be currently underutilized by global change scientists. Relational database management systems and good organization of data through the use of thoughtful database design would enable the scientific community to better share and maintain quality research data. Custodians of the data should use rigorous data administration to ensure integrity and long term value of the data resource. Still other emerging information technologies that involve the use of artificial intelligence, parallel computer architectures, and new sensors for data collection will be in relatively common use in the near term and should become part of the global science community's technical toolkit. Consideration should also be given to the establishment of Information Analysis Centers to facilitate effective organization and management of interdisciplinary data and the prototype testing and use of advanced information technology to facilitate rapid and cost-effective integration of these tools into global change science.
DOE

N91-18493# Lawrence Livermore National Lab., CA.
GCM (GENERAL CIRCULATION MODEL)-DATA INTERCOMPARISON: THE GOOD NEWS AND THE BAD
Stanley L. Grotch 12 Sep. 1990 23 p Presented at the 7th Annual Pacific Climate Workshop, Pacific Grove, CA, 10-13 Apr. 1990
(Contract W-7405-eng-48)
(DE91-005185; UCRL-JC-106085; CONF-9004266-1) Avail: NTIS HC/MF A03

General circulation models (GCMs) are being actively used to assess possible climate change due to increasing greenhouse gas concentrations. Because such simulations provide detailed climatic predictions at a wide range of scales, they are of particular interest to those making regional assessments of climatic change. It is especially important that workers using the results of such simulations be aware of some of the limitations of these results. In this study some of the positive results from these model simulations will be shown and some of the deficiencies will also be highlighted. Following an introductory section describing the nature of GCM climate simulations the issue of the spatial scales of such simulations is examined. A comparison of the results of seven GCM simulations of the current climate and the predictions of these models for the changes due to a doubling of CO2 will be discussed. In these intercomparisons, the spatial scale over which the results are compared varies from global to zonal (longitudinally averaged at a given latitude) to individual slices through the data along specified latitudes or longitudes. Finally, the dangers and pitfalls of relying on simple averages will be highlighted.
DOE

N91-18494# Midwest Research Inst., Golden, CO.
INFLUENCES OF ATMOSPHERIC CONDITIONS AND AIR MASS ON THE RATIO OF ULTRAVIOLET TO TOTAL SOLAR RADIATION
C. J. Riordan, Robert L. Hulstrom, and D. R. Myers Aug. 1990 21 p
(Contract DE-AC02-83CH-10093)
(DE90-000368; SERI/TP-215-3895) Avail: NTIS HC/MF A03

The technology to detoxify hazardous wastes using ultraviolet (UV) solar radiation is being investigated by the DOE/SERI Solar Thermal Technology Program. One of the elements of the technology evaluation is the assessment and characterization of UV solar radiation resources available for detoxification processes. This report describes the major atmospheric variables that determine the amount of UV solar radiation at the earth's surface, and how the ratio of UV-to-total solar radiation varies with atmospheric conditions. These ratios are calculated from broadband and spectral solar radiation measurements acquired at SERI, and obtained from the literature on modeled and measured UV solar radiation. The following sections discuss the atmospheric effects on UV solar radiation and provide UV-to-total solar radiation ratios from published studies, as well as measured values from SERI's data. A summary and conclusions are also given.
DOE

N91-18495# Lawrence Livermore National Lab., CA. Atmospheric and Geophysical Sciences Div.
INFLUENCE OF PRESENT AND POSSIBLE FUTURE AIRCRAFT EMISSIONS ON THE GLOBAL OZONE DISTRIBUTION
Douglas E. Kinnison and Donald J. Wuebbles Oct. 1990 7 p Presented at the 71st Annual Meeting of American Meteorological Society, New Orleans, LA, 13-18 Jan. 1991
(Contract W-7405-eng-48)
(DE91-005422; UCRL-JC-104677; CONF-910143-2) Avail: NTIS HC/MF A02

This study has used the Lawrence Livermore National Laboratory (LLNL) two-dimensional model of the global atmosphere in an evaluation of the effects on global ozone concentrations

from current subsonic aircraft emissions and from the emissions of possible future high speed civil transports (HSCT). The authors have attempted to include more realistic representations of emissions as a function of altitude and latitude in these scenarios than were included in previous sensitivity analyses. Major findings from this study are: (1) Current aircraft emissions may be having an impact on upper tropospheric ozone, leading to increasing concentrations of ozone in the upper troposphere. (2) A matrix of HSCT scenarios evaluated over a wide range of mean flight altitudes and magnitudes of NO(sub x) emissions confirmed previous analyses showing that ozone destruction becomes larger as the emissions of NO(sub x) increase and as the altitude of injection increases. (3) Model calculations indicate that a major reduction in emissions would allow the stratosphere to recover to unperturbed conditions in about a decade. (4) Sensitivity studies indicate that water vapor emissions have a moderate effect on the change in total ozone, while carbon monoxide emissions had a negligible effect. (5) Injection of NO(sub x) as HNO(sub 3) had a moderate effect on the change in total ozone. (6) The calculated change in ozone for the HSCT scenarios was very sensitive to the background atmosphere, particularly to the levels of stratospheric chlorine and concentrations of carbon dioxide, methane, and nitrous oxide. DOE

N91-18496# Oak Ridge National Lab., TN.
LIMITING THE GREENHOUSE EFFECT: OPTIONS FOR CONTROLLING ATMOSPHERIC CO2 ACCUMULATION
Steve Rayner Jan. 1991 92 p Presented at the Dahlem Research Conference, Berlin, Federal Republic of Germany, 9-14 Dec. 1990
(Contract DE-AC05-84OR-21400)
(DE91-006805; ORNL/FTR-3860) Avail: NTIS HC/MF A05

Traveler attended the Dahlem Research Conference organized by the Freien Universitat, Berlin. The subject of the conference was Limiting the Greenhouse Effect: Options for Controlling Atmospheric CO2 Accumulation. Like all Dahlem workshops, this was a meeting of scientific experts, although the disciplines represented were broader than usual, ranging across anthropology, economics, international relations, forestry, engineering, and atmospheric chemistry. Participation by scientists from developing countries was limited. The conference was divided into four multidisciplinary working groups. Traveler acted as moderator for Group 3 which examined the question, What knowledge is required to tackle the principal social and institutional barriers to reducing CO2 emissions. The working rapporteur was Jesse Ausubel of Rockefeller University. Other working groups examined the economic costs, benefits, and technical feasibility of options to reduce emissions per unit of energy service; the options for reducing energy use per unit of GNP; and the significant of linkage between strategies to reduce CO2 emissions and other goals. Draft reports of the working groups are appended. Overall, the conference identified a number of important research needs in all four areas. It may prove particularly important in bringing the social and institutional research needs relevant to climate change closer to the forefront of the scientific and policy communities than hitherto. DOE

N91-18497# Sandia National Labs., Albuquerque, NM. Dept. of Energy Conversion and Process Science.
SOLAR REFORMING OF METHANE IN A DIRECT ABSORPTION CATALYTIC REACTOR ON A PARABOLIC DISH
James F. Muir, Roy E. Hogan, Jr., Russell D. Skocypec, and Reiner Buck (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) 1990 9 p Presented at the 13th ASME-JSME International Solar Energy Conference, Reno, NV, 17-22 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-005054; SAND-90-2674C; CONF-910318-13) Avail: NTIS HC/MF A02

The concept of solar driven chemical reactions in a commercial scale volumetric receiver/reactor on a parabolic concentrator was demonstrated in the CAtalytically Enhanced Solar Absorption Receiver (CAESAR) test. Solar reforming of methane (CH4) with carbon dioxide (CO2) was achieved in a 64 cm diameter direct absorption reactor on a parabolic dish capable of 150 kW solar power. The reactor was a catalytic volumetric absorber consisting of a multi-layered, porous alumina foam disk coated with rhodium (Rh) catalyst. The system was operated during both steady state and solar transient (cloud passage) conditions. The total solar power absorbed reached values up to 97 kW and the maximum methane conversion was 70 percent. Receiver thermal efficiencies ranged up to 85 percent and chemical efficiencies peaked at 54 percent. The absorber performed satisfactorily in promoting the reforming reaction during the tests without carbon formation. However, problems of cracking and degradation of the porous matrix, nonuniform dispersion of the Rh through the absorber, and catalyst deactivation due to sintering and possible encapsulation, must be resolved to achieve long term operation and eventual commercialization. DOE

N91-18498# Lawrence Livermore National Lab., CA.
UNCERTAINTIES IN FORECASTING FUTURE CLIMATE
Michael C. MacCracken Nov. 1990 6 p Presented at the Institut De La Vie International Conference, Deauville, France, 12-16 Nov. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005225; UCRL-JC-105293; CONF-9011160-1) Avail: NTIS HC/MF A02

The increasing atmospheric concentrations of carbon dioxide, methane, chlorofluorocarbons, and other trace gases (collectively, greenhouse gases) pose a three-part challenge: (1) What the changes to atmospheric composition and the climate system will be; (2) What impacts (both detrimental and beneficial) these changes will induce on the biosphere and natural and societal resources; and (3) What the appropriate response, if any, might be when considering the changes themselves, the resulting impacts, and the benefits and other impacts of the activities generating the emissions. This brief summary will address only areas of agreement and areas of uncertainty related to the first challenge. DOE

N91-18499# Idaho National Engineering Lab., Idaho Falls.
RECOMMENDED METHODS FOR STATISTICAL ANALYSIS OF DATA CONTAINING LESS-THAN-DETECTABLE MEASUREMENTS
Corwin L. Atwood, Larry G. Blackwood, Gerald A. Harris, and Cynthia A. Loehr Sep. 1990 105 p
(Contract DE-AC07-76ID-01570)
(DE91-006102; EGG-SARE-9247) Avail: NTIS HC/MF A06

This report is a manual for statistical workers dealing with environmental measurements, when some of the measurements are not given exactly but are only reported as less than detectable. For some statistical settings with such data, many methods have been proposed in the literature, while for others few or none have been proposed. This report gives a recommended method in each of the settings considered. The body of the report gives a brief description of each recommended method. Appendix A gives example programs using the statistical package SAS, for those methods that involve nonstandard methods. Appendix B presents the methods that were compared and the reasons for selecting each recommended method, and explains any fine points that might be of interest. This is an interim version. Future revisions will complete the recommendations. DOE

N91-18500# Brookhaven National Lab., Upton, NY. Biosystems and Process Sciences Div.
CONVERSION OF BIOMASS TO METHANOL AND ITS EFFECT ON CO2 EMISSIONS
Meyer Steinberg Oct. 1990 17 p Revised
(Contract DE-AC02-76CH-00016)
(DE91-006303; BNL-44653-REV-10/90) Avail: NTIS HC/MF A03

The purpose for this report is to present a preliminary analysis of various processes for conversion of biomass to methanol fuel with the objective of determining the effect of these processes on net CO2 emissions. The analysis is made primarily on the basis

of first principles of mass and energy balances. There are at least four systems that can produce methanol from biomass (defined as wood or lignocellulose). These are reviewed and assessed. DOE

N91-18501# Stockholm Univ. (Sweden). Dept. of Meteorology.
PARAMETRIC AEROSOL SAMPLING AT LOW CONCENTRATION LEVELS
J. A. Ogren and J. Heintzenberg Nov. 1990 13 p Sponsored by Swedish Environmental Protection Agency
(AA-1; ISSN-1101-4814; ETN-91-98625) Avail: NTIS HC/MF A03

A parametric controller developed to improve aerosol sampling at low concentration levels is described. The total particle concentration was used as controlling parameter and the instrument adjusted the sampling status to concentration changes in the working range 0 to 10,000/cu cm. The control algorithm allowed for slow concentration changes to be followed by the samplers while excluding rapid concentration increases caused by suspected contamination. Power for the condensation nuclei controller was provided by the battery backup unit which minimizes the negative effects of power failure. The operation of the instrument is illustrated with results from an Arctic baseline monitoring system. The particle counter could be replaced by any rapid sensor for parametric sampling in atmospheric experiments, to measure wind speed, relative humidity or trace gas concentrations. The logic of the controlling algorithm can be easily changed. ESA

N91-18502# Oak Ridge National Lab., TN.
THE POTENTIAL ROLE OF NUCLEAR POWER IN CONTROLLING CO2 EMISSIONS
W. Fulkerson, J. E. Jones, J. G. Delene, A. M. Perry, and R. A. Cantor 1990 38 p Presented at the Dahlem Workshop on Limiting Greenhouse Effect: Options for Controlling Atmospheric CO2 Accumulation, Berlin, Fed. Republic of Germany, 9-14 Dec. 1990
(Contract DE-AC05-84OR-21400)
(DE91-006665; CONF-901262-3) Avail: NTIS HC/MF A03

Nuclear power currently reduces CO2 emissions from fossil fuel burning worldwide by about 8 percent (0.4 Gt(C)/yr). It can continue to play an important role only if it can grow substantially in the next 50 years. For such growth to occur public confidence will need to improve throughout the world. That might happen if: (1) other non-fossil alternatives are inadequate to meet electricity demand growth, (2) the risks to society from global warming are perceived to be very high, (3) nuclear technology improves substantially, and (4) an international institutional setting is devised to manage the nuclear enterprise so that the technology is available to all nations while catastrophic accidents and proliferation of nuclear weapon capabilities are avoided. It seems feasible that the necessary technological and institutional advances can be devised and tested over the next 20 years. It is also plausible that the direct costs of electricity produced by the system would be in the range of 50 to 100 mills/kWhr (1990 dollars) delivered to the grid. In other words, the direct costs of nuclear power should not be greater than they are today. Achieving such an outcome will require aggressive technical and institutional RD and D performed in a cooperative international setting. If rapid growth of nuclear power can begin again in 15 to 20 years it could supply 30 to 50 percent of world electricity in 50 years and cut CO2 emission rates by up to 2.5 Gt(C)/yr. This would be a substantial contribution to controlling greenhouse gases, but it is not sufficient. Improved efficiency and various renewable energy sources must also grow rapidly if CO2 emission rates from electricity generation are to be reduced from the current value of about 2 Gt(C)/yr. DOE

N91-18503# Lawrence Livermore National Lab., CA.
SENSITIVITY OF STRATOSPHERIC OZONE TO PRESENT AND POSSIBLE FUTURE AIRCRAFT EMISSIONS
Donald J. Wuebbles and Douglas E. Kinnison Aug. 1990 18 p Presented at the German Aerospace Research Establishment Seminar on Air Traffic and the Environment, Bonn, Fed. Republic of Germany, 15-16 Nov. 1990
(Contract W-7405-eng-48)
(DE91-007140; UCRL-JC-104730; CONF-9011178-1) Avail: NTIS HC/MF A03

The aircraft industry is showing renewed interest in the development of supersonic, high flying aircraft for intercontinental passenger flights. There appears to be confidence that such high-speed civil transports can be designed, and that aircraft will be economically viable as long as they are also environmentally acceptable. As such, it is important to establish the potential for such environmental problems early in the aircraft design. Initial studies with LLNL models of global atmospheric chemical, radiative, and transport processes have indicated that substantial decreases in stratospheric ozone concentrations could result from emissions of NO(x) from aircraft flying the stratosphere, depending on the fleet size and magnitude of the engine emissions. The purpose of this study is to build on previous analyses of potential aircraft emission effects on ozone in order to better define the sensitivity of ozone to such emissions. In addition to NO(x), the effects of potential emissions of carbon monoxide and water vapor are also examined. More realistic scenarios for the emissions as a function of altitude, latitude, and season are examined in comparison to prior analyses. These studies indicate that the effects on ozone are sensitive to the altitude and latitude, as well as the magnitude, of the emissions. DOE

N91-18994*# Puerto Rico Univ., Rio Piedras. Dept. of Civil Engineering.
TECHNIQUE FOR ASSESSING VEGETATION-INDUCED MOISTURE FLUX, WITH IMPLICATIONS FOR GLOBAL CLIMATE MODELING
Emir Jose Macari *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N91-18504 Princeton Univ., NJ.
TILTED ROSSBY-WAVE CRITICAL LAYERS IN STRATIFIED ATMOSPHERES Ph.D. Thesis
Frederick Melvin Parham, Jr. 1989 116 p
Avail: Univ. Microfilms Order No. DA8920354

The quasigeostrophic potential vorticity equations linearized about a zonal mean flow, which describe Rossby waves, become singular at the critical level where the mean flow equals the wave's phase velocity. The Wentzel-Kramer-Brillouin solution describes a superposition of two eigenmodes, each of which has meridional structure corresponding to that of Dickenson's (1968) two-dimensional solutions. Rossby waves in a continuously stratified atmosphere are studied whose basic state zonal winds vary over large meridional scales. Again, WKB is used. The linearized potential vorticity equation is separable to lowest order. The WKB analysis applies to the outer solution. The inner solution, which provides a condition on the jump in the derivative of the outer solution across the critical line, depends on whether the critical line is desingularized by damping or by weak nonlinearity. Using the results on the matching across the critical line, the vertical structure eigenfunctions and eigenvalues are calculated for low critical layer heights with the basic state as given in the Charney model. Asymptotic values of the eigenvalues are also calculated as the critical height approaches zero or infinity. Finally, the eigenfunctions and eigenvalues are used to calculate the structure of waves on a basic state with a region of easterly winds surrounded by westerlies. The assumption of constant N makes it possible to

compute the wave-forced change in the mean flow by means of modified Bessel functions. Dissert. Abstr.

N91-18505*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SAM 2 MEASUREMENTS OF THE POLAR STRATOSPHERIC AEROSOL. VOLUME 9: OCTOBER 1982 - APRIL 1983
L. R. McMaster and K. A. Powell (ST Systems Corp., Hampton, VA.) Washington Feb. 1991 77 p
(NASA-RP-1244; L-16802-VOL-9; NAS 1.61:1244) Avail: NTIS HC/MF A05 CSCL 04A

The Stratospheric Aerosol Measurement (SAM) II sensor aboard Nimbus 7 is providing 1.0 micron extinction measurements of Antarctic and Arctic stratospheric aerosols with a vertical resolution of 1 km. Representative examples and weekly averages including corresponding temperature profiles provided by NOAA for the time and place of each SAM II measurement are presented. Contours of aerosol extinction as a function of altitude and longitude or time are plotted, and aerosol optical depths are calculated for each week. Typical values of aerosol extinction and stratospheric optical depth in the Arctic are unusually large due to the presence of material from the El Chichon volcano eruption in the Spring of 1982. For example, the optical depth peaked at 0.068, more than 50 times background values. Typical values of aerosol extinction and stratospheric optical depth in the Antarctic varied considerably during this period due to the transport and arrival of the material from the El Chichon eruption. For example, the stratospheric optical depth varied from 0.002 in October 1982, to 0.021 in January 1983. Polar stratospheric clouds were observed during the Arctic winter, as expected. A representative sample is provided of the ninth 6-month period of data to be used in atmospheric and climatic studies. Author

N91-18506# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Panel.
IONOSPHERIC MODIFICATION AND ITS POTENTIAL TO ENHANCE OR DEGRADE THE PERFORMANCE OF MILITARY SYSTEMS
Oct. 1990 483 p In ENGLISH and FRENCH Symposium held in Bergen, Norway, 28-31 May 1990
(AGARD-CP-485; ISBN-92-835-0590-5) Copyright Avail: NTIS HC/MF A21; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The propagation medium is, in effect, an integral part of many military systems. For the most part, interest in the propagation medium was focused on identifying and quantifying the limitations it imposes on systems. The results of on-going theoretical and experimental research show potential for modifying selected regions of the ionosphere in order to affect radio wave propagation. A variety of modification techniques are being investigated, both ground- and space-based, to increase or decrease existing ionization or to create independent artificial plasmas. These techniques include high power radio waves, lasers, particle beams, and chemical releases. In addition, recent development in high power RF sources raise concerns over system limitations, due to self induced anomalous absorption, ray path deviation and clutter. These proceedings present the current state of ionospheric modification technology. For individual titles, see N91-18507 through N91-18549.

N91-18507# Leicester Univ. (England). Dept. of Physics and Astronomy.
THE PHYSICS OF GROUND BASED HEATING
Tudor B. Jones *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 9 p (For primary document see N91-18506 10-46)
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The first indication that powerful radiowaves could modify the earth's ionosphere was the discovery of the Luxembourg Effect in 1933, (Tellegen, 1933). The transfer of the modulation of the high power Luxembourg broadcasts on to weaker signals propagating through the same region of the ionosphere could only be explained in terms of ionospheric 'cross modulation' (Bailey and Martyn, 1934). The ionospheric electron temperature and hence its electron density, were changed by the high power wave and these subsequently influenced other radio signals propagated through the modified region. In the early 1970s, it was realized that high power radio wave could produce many instabilities in the ionosphere in addition to the collision phenomena associated with the Luxembourg effect. Author

N91-18508# Air Force Geophysics Lab., Hanscom AFB, MA. Ionospheric Physics Div.
HIGH POWER HF MODIFICATION: GEOPHYSICS
Herbert C. Carlson, Jr. *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p (For primary document see N91-18506 10-46)
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As the electric field and power density of radio frequency (RF) radiation increases continuously in a plasma, the response of the plasma to the incident energy changes discontinuously. This follows from a complex of competing physical processes, each generally with its own power dependent threshold, and plasma instabilities each with its own growth and decay rate. Nonlinear power dependencies, boundary condition dependencies on past histories of the plasma conditions, dependence on proximity to plasma resonances, and nonlinear mixing in the plasma to up and down convert with respect to resonances, all conspire to make experimental guidance invaluable to theoretical development. The experiment ahs demonstrated that with increasing HF power one passes the threshold of detectability sequentially from: passive transmission, to cross-modulation, to thermal bulk heating, to parametric and other instabilities with plasma structuring and stimulated electromagnetic radiation, to electron acceleration and airglow, to reported stimulated ionization. The RF propagation and emission environment is affected through the VLF to GHz range by lensing, scattering, modulation, and simulated emission. The optical background and emission character is affected over a very wide spectrum by electron impact and temperature enhancement altering translational, rotational and vibrational temperatures (as well as raising fine structure population distribution questions). A set of geophysical effects are address over this range, and participation is invited in anticipation of what effects lie beyond the next threshold (of ionospheric response to higher HF illumination). The exciting upgrade of the Heater at Tromso and emerging new HF modifier plans in the U.S. are partial motivation for such conjecture. Author

N91-18509# Clemson Univ., SC.
REVIEW OF SOVIET IONOSPHERIC MODIFICATION RESEARCH
Lewis M. Duncan and Robert L. Showen (SRI International Corp., Menlo Park, CA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 9 p Sponsored in part by AFGL and LANL (For primary document see N91-18506 10-46)
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A technical assessment of Soviet research of the past five to tens years in ionospheric modification by high-power radio waves was reviewed and provided. This review includes a comprehensive survey of Soviet published literature, conference proceedings, and direct discussions with the involved Soviet researchers. The current state of the art for Soviet research in this field is evaluated, identifying areas of potential breakthrough discoveries, and discussing implications of this work for emerging technologies and future applications. This assessment is divided into the categories of basic research, advanced research, and applications. Basic research is further subdivided into studies of the modified natural geophysical environment, nonlinear plasma physics, and polar geophysical studies. Advanced research topics include the

generation of artificial ionization mirrors and high-power oblique propagation effects. A separate comparative assessment of Soviet theoretical work is also included. The evaluation of practical and potential applications of this research discusses the utility of ionospheric modification in creating disturbed radio wave propagation environments, and its role in current and future remote-sensing and telecommunication systems. The Soviet effort in ionospheric modification sustains theoretical and experimental research at activity levels considerably greater than that found in comparable programs in the West. Notable strengths of the Soviet programs are its breadth of coverage, large numbers of scientific participation, theoretical creativity and insight, and its powerful radio wave transmitting facilities. Weakness in the Soviet effort include ccomputational limits in numerical analysis of nonlinear processes, inferior experimental diagnostic capabilities, and an apparent tendency of experimental program to validate theoretical predictions as opposed to exploring new phenomena. A recent review of Soviet ionospheric modification research is given by Migulin and Gurevich. Author

N91-18510# Rice Univ., Houston, TX.
HISTORICAL OVERVIEW OF HF IONOSPHERIC MODIFICATION RESEARCH
William E. Gordon and Lewis M. Duncan (Clemson Univ., SC.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p (For primary document see N91-18506 10-46)
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Radio waves have inadvertently modified the Earth's ionospher since the Luxembourg observations of Tellegen in 1933 and perhaps since Marconi in 1901. The history of ionospheric modification by radio waves is reviewed, beginning with Marconi, describing the Luxembourg effect and its explanations, and its early use to deduce the properties of the lower ionosphere in the 1930s. The measurements became more sophisticated in the 1950s, leading to the call for high-power high-frequency modification experiments in the upper ionosphere. Beginning in 1970, radio facilities became available of sufficient powers to induce changes in the ionospheric plasma detectable by a wide array of diagnostic instruments and techniques. A summary of these effect is presented based upon work up to 1990. These studies were originally motivated as a means of better understanding the natural ionosphere using a weak perturbational approach. However, a rich spectrum of nonlinear wave-plasma interactions was quickly discovered and ionospheric modifications research became strongly motivated by issues in basic plasma physics. The ionosphere and near-Earth space are now exploited as an exceptional plasma laboratory-without-walls for the study of fundamental plasma processes requiring large spatial or temporal scales. A brief overview of these processes and phenomena is presented, illustrated using results obtained from the Arecibo ionospheric modification facilities. The lessons learned and phenomena explored thus far offer many opportunities for controlling the ionospheric environment critical to many civilian and military telecommunications systems, both to disrupt systems normally operational and to create new propagation paths otherwise unavailable. Author

N91-18511# Office of Naval Research, Arlington, VA.
IONOSPHERIC MODIFICATION RESEARCH AT HIPAS
Richard G. Brandt *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p (For primary document see N91-18506 10-46)
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The High Power Auroral Simulation (HIPAS) ionospheric heating facility radiates a total power of 1.2 MW with a effective radiated power (ERP) of 84 MW. It presently operates at an HF frequency of 2.85 MHz but is tunable to about 5 MHz. Electrojet modulation experiments were conducted at frequencies from 5 Hz to 5 MHz. The magnetic field amplitudes, measured close to the heater, can be 1 pT or larger under very strong electrojet conditions. Even under much weaker conditions when the amplitudes are highly variable, the phase of the ELF signal is relatively stable. The efficiency of converting HF to ELF is presently too low for a practical communication system. Beam painting was proposed as a method for improving the conversion efficiency in D region heating by causing a much larger area of the ionosphere to radiate coherently; this concept will be tested using microsecond beam steering. Use of shorter heating pulses (lower duty cycle) already seems promising. Even larger gains are expected for E region heating as compared to D region heating. Author

N91-18512# EISCAT Scientific Association, Ramfjordbotn (Norway).
VLF, ELF, AND ULF WAVE RESEARCH USING THE TROMSO HEATING FACILITY
Michael T. Rietveld, R. Barr, P. Stubbe, A. Maul, H. Kopka (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany, F.R.), and R. L. Dowden *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p Sponsored in part by DFG (For primary document see N91-18506 10-46)
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Results from the Tromso Heating Facility in the areas of wave generation from ULF (mHz) to VLF (kHz) frequencies, as well as VLF wave propagation under heated ionospheres are presented. Results from similar facilities in the USSR and USE are not included. Author

N91-18513# Leicester Univ. (England). Dept. of Physics.
OBSERVATIONS OF THE ANOMALOUS ABSORPTION OF DIAGNOSTIC RADIO WAVES DURING IONOSPHERIC MODIFICATION AT ARECIBO
A. J. Stocker, T. R. Robinson, and Tudor B. Jones *In* AGARD, Ionospheric Modification and its Potential to Enhance of Degrade the Performance of Military Systems Oct. 1990 6 p (For primary document see N91-18506 10-46)
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The theory indicates that the anomalous absorption produced during modification of the ionosphere by means of high power radio waves is a dependent on the magnetic dip angle. Recent measurements of the anomalous absorption at Arecibo, Puerto Rico, are found to be considerably smaller in magnitude than those previously reported for the high latitude site at Tromso, Norway. Author

N91-18514# Danish Meteorological Inst., Copenhagen. Dept. of Geophysics.
THEORY OF A THERMAL RESONANCE INSTABILITY IN THE E-REGION OF THE IONOSPHERE
P. Hoeg *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 15 p (For primary document see N91-18506 10-46)
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Auroral region modulation experiments have shown, that strong electromagnetic HF waves are generating short-scale field-aligned irregularities i the E region of the high latitude ionosphere. For overdense conditions the instabilities are excited close to the reflection altitude of the O-mode heating wave. The theory presented here for a thermal resonance instability are capable of explaining these observations for magnetically quiet to moderate disturbed conditions. The dispersion relation for a thermal resonance instability is considered, where differential heating by collisional dissipation is more important then the action of the ponderomotive force. Thus special attention is paid to the transport theory, when a constant ambient electric field is applied to the plasma. For irregularities with transverse scale lengths much smaller than the wavelength of the heating wave, thermal nonlinearity causes strongly enhanced electron density fluctuations in regions of excess heating wave intensity. In the region, where

the upper hybrid frequency of the plasma matches the heating wave frequency, the initial growth of irregularities takes place. The dispersion relation for the electrostatic response of the heating wave together with the full theory of transport lead to criteria for the threshold electric heating wave field, growth rate and drift velocity of the instabilities. Numeric simulations of the theory demonstrate, the magnitude of the threshold electric field as the function of the altitude in the ionosphere, the magnitude and direction of the phase velocity of unstable waves and the influence of the constant ambient electric field on the threshold criteria.
Author

N91-18515# Tromsoe Univ. (Norway).
ON THE VALIDITY OF THE WEAK TURBULENCE APPROXIMATION
Alfred Hanssen and E. Mjolhus *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p Sponsored in part by Norwegian Research Council (For primary document see N91-18506 10-46)
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The weak Langmuir turbulence approach to explain the artificial plasma line in ionospheric radio modification experiments, is examined. The mathematical model is a version of the one dimensional Zakharov equations, including damping and a nonlinear ac driving. Numerical full wave solutions to this set of equations are compared with the saturation spectrum determined by a wave kinetic equation derived from the same set of equations. It was found that a distance below the O-mode reflection level, omega - omega(sub p) is much greater than (m/M)omega(sub p) (omega is the applied frequency; omega(sub p) is the plasma frequency; m,M is the electron and ion masses), the full wave solution is in good qualitative agreement with the cascade theory. The number of cascades seen in the full wave solution is generally smaller than that of the saturation spectrum of the wave kinetic equation. On the other hand, in the reflection region omega - omega(sub p) is less than (m/M)omega(sub p), a qualitatively different process takes place, describable as many localized cycles of nucleation, (one dimensional driven) collapse, and burnout, similar to the results of Doolen et. al. These findings are discussed with respect the experiments performed in Arecibo and Tromso. Author

N91-18516# Naval Research Lab., Washington, DC. Space Plasma Branch.
THEORY OF LARGE-SCALE HF HEATING PROCESSES IN THE UNSTRUCTURED AND STRUCTURED IONOSPHERE
M. J. Keskinen, P. K. Chaturvedi, and Sidney L. Ossakow *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p (For primary document see N91-18506 10-46)
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Theoretical aspects of large-scale HF heating processes in the unstructured and structured ionosphere were studied. For the unstructured case, an analytical model is presented for the generation, convection, and steepening of HF-induced density cavities. The nonlinear propagation of high power HF in steepened cavities is discussed. Properties of thermal self-focusing instabilities in the presence of a convecting and steepened cavity is studied. For the structured ionosphere, parameteric coupling processes are discussed for a large amplitude HF pump wave with both F-region, i.e., interchange, current-convective, and ion cyclotron and E-region, i.e., two-stream and gradient-drift ionospheric instabilities which instabilities were proposed to account, in part, for naturally occurring ionospheric irregularities. It is shown that these instabilities may be stabilized or destabilized using high power HF heaters.
Author

N91-18517# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.
DUCT MODEL FOR THE DUTY-CYCLE VARIATION OF THE PLASMA-LINE OVERSHOOT DURING CYCLIC HEATING AT ARECIBO
D. B. Muldrew *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 6 p (For primary document see N91-18506 10-46)
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In a recent publication on ionospheric heating by Sulzer et al., (1989), the effects of suddenly changing the duty cycle, during on-off cycling of the HF transmitter, on the plasma-line (PL) overshoot are strikingly illustrated. When the duty cycle was suddenly decreased, the overshoot lifetime changed gradually over about 1 min from roughly 0.1 to most then 0.5 s. When the duty cycle was suddenly increased, the lifetime changed gradually from more than 0.5 to roughly 0.1 s. For a still higher duty cycle, the PL intensity began to pulsate dramatically. The Langmuir (L) waves responsible for the PL grown by the parametric-decay instability and propagates in magnetic-field-aligned ionization ducts having a density decrement relative to the ambient density outside the duct. The change in the decrement depends both on the ponderomotive force of the trapped L waves and on heating due to damping of the L waves. When the HF is on, the decrement increases. When the HF is off, the decrement decreases. Rapid decay of the L waves (i.e., decay of the overshoot) by Landau damping begins when the decrement exceeds a certain level. The duty-cycle observations can be explained with this model. Author

N91-18518*# Polytechnic Univ., Farmingdale, NY.
A THEORETICAL MODEL FOR THE TEMPORAL EVOLUTION OF HF-ENHANCED PLASMA LINES
S. P. Kuo, A. Y. Ho, M. C. Lee, and F. T. Djuth (Aerospace Corp., Los Angeles, CA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 9 p (For primary document see N91-18506 10-46)
(Grants NAG5-1055; NSF ATM-88-16467; AF-AFOSR-0316-85; AF-AFOSR-0127-88)
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The HF-enhanced plasma lines (HFPLs) observed in the Arecibo heating experiments refer to the radar returns at frequencies near the sum and difference of the radar frequency and the HF-heatear frequency. Those enhanced spectral lines are caused by backscattor of radar signals from parametrically excited plasma waves having a wavenumber of 18 n. A nonlinear theory was developed to describe the temporal evolution of those specified plasma waves and their originating altitude interval of HFPLs observed at Arecibo, Puerto Rico are explained. The theoretical resultsagree well with the observation (Djuth and Sulzer, 1989).
Author

N91-18519# Leicester Univ. (England). Dept. of Physics and Astronomy.
ENHANCED FADING RATES PRODUCED DURING IONOSPHERIC MODIFICATION
Tudor B. Jones and A. Wilkinson *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems 7 Oct. 1990 p stems (For primary document see N91-18506 10-46)
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When very high power radio waves are reflected from the ionosphere, modifications in the physical characteristics of the ambient plasma are produced. These include the production of field aligned plasma striations with scale size across the geomagnetic field lines ranging from a few meters to a few kilometers. The presence of these striations produces anomalous absorption of both the heater wave itself and of other HF signals

propagation through the modified region. During experiments at Tromso, Norway, with the heating facility constructed by the Max Planck Institut fur Aeronomy, Lindau, West Germany, marked changes in the fading rate of HF signals reflected from the heated volume were noted. These rapid fluctuations in signal amplitudes are thought to be produced by medium scale striations generated during the heating process. An estimate of scale size of these striations is made from the experimental data. Author

N91-18520# Naval Research Lab., Washington, DC. Space Plasma Branch.

LARGE SCALE PLASMA IRREGULARITIES AND AIRGLOW ENHANCEMENTS FROM IONOSPHERIC HEATING

Paul A. Bernhardt, Harvey Rowland, Lewis M. Duncan, and Craig A. Tepley (Arecibo Ionospheric Observatory, Puerto Rico.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 8 p (For primary document see N91-18506 10-46)

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Ionospheric modification with high power radio waves may generate plasma irregularities and airglow clouds. Large scale irregularities are produced in a convecting F-layer by a mechanism called the plasma relaxation oscillator. When a continuous beam of powerful electromagnetic waves heats the ionosphere, a cavity is produced by thermal pressure gradients. The cavity drifts under the influence of ambient electric fields causing the vertically-incident, radio beam to be refracted from the zenith. At some point, the cavity can no longer 'capture' the beam and it returns to the zenith to form another cavity. This relaxation process repeats to yield irregularities on the scale of the heater beam diameter. Airglow enhancements are produced by energetic electrons accelerated out of the heated region. Large amplitude electrostatic waves may be excited by linear mode coupling, by parametric decay instabilities, and by strong plasma turbulence. This occurs near the point where the plasma frequency of the ionosphere matches wave frequency. The electrostatic waves accelerate ambient electrons to high enough energy to collisionally excite ambient oxygen atoms. Clouds of enhanced red-line (630.0 nm) and green-line (557.7 nm) emissions were recorded with low-light-level imaging systems located at Arecibo, Puerto Rico. Comparison of the imager data with data from the Arecibo incoherent scatter radar shows that artificial airglow clouds are physically tied to the density cavities and to regions of enhanced electrostatic waves by the earth's magnetic field lines. At currently available power levels (around 80 MW effective radiated power), HF modification yields 10-30 percent fluctuations in density and 10-100 Rayleigh enhancements in airglow intensity. Author

N91-18521# Pacific-Sierra Research Corp., Los Angeles, CA.

IONOSPHERIC HEATING WITH OBLIQUE HF WAVES

Edward C. Field, Jr. and Ron M. Bloom *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p (For primary document see N91-18506 10-46)

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Calculations of ionospheric electron density perturbations and ground-level signal changes produce by intense oblique high frequency (HF) transmitters are presented. This analysis considers radio field focusing at caustics, the consequent joule-heating of the surrounding plasma, heat conduction, diffusion, and recombination processes: these being the effects of a powerful oblique 'modifying' wave. It neglects whatever plasma instabilities might occur. Then effects on a secondary 'test' wave that is propagated along the same path as the first are investigated. Calculations predict ground-level field-strength reductions of several dB in the test wave for modifying waves having ERP in the 85 to 90 dBW range. These field-strength changes are similar in sign, magnitude, and location to ones measured in Soviet experiments. The results are sensitive to the model ionosphere assumed, so future experiments should employ the widest possible range of frequencies and propagation conditions. An effective power of 90 dBW seems to be a sort of threshold that, if exceeded, results in substantial rather than small signal changes. The conclusions are based solely on joule-heating and subsequent defocusing of waves passing through caustic regions. Author

N91-18522# TRW Defense and Space Systems Group, Redondo Beach, CA. Space and Technology Group.

MODELING OF HF PROPAGATION AND HEATING IN THE IONOSPHERE

Timothy M. Smith, Merit M. Shoucri, and Thomas M. Wagner *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p Sponsored in part by RADC, Hanscom AFB, MA (For primary document see N91-18506 10-46)

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A comprehensive numerical implementation of plasma geometric optics is being enhanced and adapted to the problem of self-consistent ionospheric propagation of high power, high frequency (HF) radar signals. Emphasis is placed on realistic and rigorous description of the propagating waves so that geometric and spectral characteristics of nonlinear ionospheric effects can be predicted in detail. When improvements are complete, a plasma geometric optics code will be used in conjunction with an ionospheric transport code to determine self-consistently the HF radiation field and quasilinear modifications of ionospheric plasma properties due to ohmic dissipation of the HF radiation. This allows detailed study of nonlinear phenomena such as beam self-focusing, formation of large-scale density cavities and striations, and induced wave ducting. An overview of the theory underlying the modeling of radiation propagation and ohmic power deposition is given, and current results from the plasma geometric optics code together with associated ionospheric power deposition profiles are presented. Detailed structure of ordinary and extraordinary mode caustics formed in a manner consistent with a realistic antenna pattern and birefringence upon entrance into the ionosphere are evident. Author

N91-18523# Lowell Univ., MA. Center for Atmospheric Research.

MODELING AND DESIGN FOR A NEW IONOSPHERIC MODIFICATION EXPERIMENT

Gary S. Sales, Ian G. Platt, D. Mark Haines, Yuming Huang, and John L. Heckscher (Air Force Geophysics Lab., Hanscom AFB, MA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 11 p (For primary document see N91-18506 10-46)

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Plans are now underway to carry out new high frequency oblique ionospheric modification experiments with increased radiated power using a new high gain antenna system and a 1 MW transmitter. The output of this large transmitting system will approach 90 dBW. An important part of this program is to determine the existence of threshold for nonlinear effects by varying the transmitter output. For these experiments, a high frequency probe system, a low power oblique sounder, is introduced to be used along the same propagation path as the high power disturbing transmitter. The concept was first used by soviet researchers to insure that this diagnostic signal always passes through the modified region of the ionosphere. The HF probe system will use a low power (150 W) CW signal shifted by approximately 40 kHz from the frequency used by the high power system. The transmitter for the probe system will be at the same location as the multiple antennas to measure the vertical and azimuthal angle of arrival as well as the Doppler frequency shift of the arriving probe signal. The three antenna array will be in an 'L' configuration to measure the phase differences between the antennas. At the midpath point a vertical sounder will provide the ionospheric information necessary for the frequency management of the experiment. Real-time processing will permit the site operators to evaluate the performance of the system and make adjustments during the experiment. A special ray tracing computer will be used to provide

real-time frequencies and elevation beam steering during the experiment. A description of the system and the analysis used in the design of the experiment are presented. Author

N91-18524# Royal Aerospace Establishment, Farnborough (England). Applied Ionospheric Physics Div.
OBLIQUE HEATING OF THE AURORAL IONOSPHERE BY LF/MF TRANSMITTERS
Paul S. Cannon, M. J. Rycroft, and T. Turunen (Geophysical Observatory, Sodankyla, Finland) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p (For primary document see N91-18506 10-46)
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The generation of extremely low frequency (ELF) signals due to oblique heating of the auroral ionosphere by signals from ELF modulated LF/MF radio transmitters is described. A part from signals of natural origin, timing signals (six pips which occurred on the hour) were received. The pips of frequency 1 kHz, duration 105 ms and field strength of approximately 0.1 pT exhibit a favored source location of approximately 150 km south-south-east of Sodankyla. The pips are shown to occur only when there is significant local magnetic activity and when the auroral electrojet is enhanced. The originating signals are demonstrated to be of Soviet origin and due to LF/MF broadcast transmitters several hundred kilometers away from the ELF source location. Various mechanisms which could account for a localized generation region far from the transmitters are discussed. The favored mechanism involves in-phase heating due to two or more transmitters.
Author

N91-18525# Air Force Geophysics Lab., Hanscom AFB, MA. Ionospheric Physics Div.
ARTIFICIAL IONOSPHERIC MIRRORS (AIM). A: CONCEPT AND ISSUES
Paul A. Kossey, John L. Heckscher, Ramy A. Shanny, and Edward C. Field, Jr. (Pacific-Sierra Research Corp., Los Angeles, CA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 11 p (For primary document see N91-18506 10-46)
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Theoretical and experimental research on the creation, maintenance, and control of artificial layers of ionization in the 50 to 90 km altitude range. The focus of the research is to assess the potential for exploiting such so-called 'artificial ionospheric mirrors' (AIM) as scatterers of radio waves to distances well beyond line-of-sight. The AIM concept is discussed in terms of a specific technical approach, the use of ground-based, very high power, RF waves to breakdown the atmosphere. The concept is described in terms of RF requirements to produce breakdown, electron production and losses, resultant ionization densities, and their lifetimes. In addition, issues concerning the RF reflection properties of artificial patches of ionization in the atmosphere are considered, and the potential of exploiting the AIM concept for practical applications is introduced. Author

N91-18526# ARCO Power Technologies, Inc., Washington, DC.
PHYSICS OF RF BREAKDOWN FOR AIM APPLICATIONS
K. Papadopoulos, Tom Wallace, P. Vitello, Ramy A. Shanny, K. Tsang, and Pierre Lallement *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p (For primary document see N91-18506 10-46)
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Both a simple test particle approach and a complete kinetic calculation are used to predict the net electron production rate of an RF signal under conditions appropriate for an artificial ionospheric mirror (AIM) system. These predictions are compared with each other and with experimental data and are found to be in good agreement. The test particle based formula is incorporated into a model which calculates the one-dimensional vertical electron density profile created by a ground-based RF heater, and the performance of a baseline heater design is investigated, providing the foundation for the specification of a baseline AIM heater system. Author

N91-18527# Los Alamos National Lab., NM.
CROSSED-MICROWAVE-BEAM AIR IONIZATION LABORATORY EXPERIMENTS
W. T. Armstrong, R. Karl, M. Kelly, R. Roussel-Dupre, M. Buchwald, C. D. Sutherland, J. Zinn, R. Alvarez, P. Bolton, and G. Sieger (Lawrence Livermore National Lab., CA.) et al *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p Sponsored in part by DOE and AF (For primary document see N91-18506 10-46)
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Detailed laboratory measurements and theoretical modeling relevant to the production, geometrical description and decay of microwave-induced air ionization for an upper atmospheric RF reflecting layer are reported. It is found that breakdown thresholds are adequately predicted by fluid models and simplified scaling models with refinement by kinetic models being important at lower pressures. Repetitive pulse sustainment was demonstrated to be straightforward with a commensurate reduction in sustainment power levels. However, establishment of a convenient breakdown geometry for specular RF reflections, other than a single layer in a crossed beam geometry, was not obtained. Detailed density decay measurements qualitatively support simple estimates of decay times and indicate ionization dwell times of tens of milliseconds. Chemistry studies indicate three N(x)O(x) species will be produced. However, large N(x)O(x) production does not appear as a concern for relatively small, low repetition rate, proof of concept atmospheric experiments. A realizable proof of concept experiment is found with simple optimization criteria which is corroborated by laboratory measurements and theoretical simulations. Tail-erosion appears as a potentially severe limitation in atmospheric experiments beyond the proof of concept level, suggesting use of multiple-beam systems. Author

N91-18528*# Polytechnic Univ., Farmingdale, NY.
ON THE FEASIBILITY OF MICROWAVE PRODUCED BRAGG REFLECTOR: EXAMINED BY THE CHAMBER EXPERIMENT
S. P. Kuo, Y. S. Zhang, Paul A. Kossey, and Robert J. Barker (Air Force Office of Scientific Research, Bolling AFB, Washington, DC.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p (For primary document see N91-18506 10-46)
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A set of parallel plasma layers is generated by two intersecting microwave pulses in a chamber containing dry air at a pressure comparable to the upper atmosphere. The dependencies of breakdown conditions on the pressure and pulse length are examined. The results are shown to be consistent with the appearance of tail erosion of microwave pulse caused by air breakdown. A Bragg scattering experiment using the plasma layers as a Bragg reflector is then performed. Both time domain and frequency domain measurements of wave scattering are conducted. The results are found to agree very well with the theory. Moreover, the time domain measurement of wave scattering provides an unambiguous way for determining the temporal evolution of electron density during the first 100 microsec period. A Langmuir double probe is also used to determine the decay rate of electron density during a later time interval (1 to 1.1 ms). The propagation of high power microwave pulses through the air is also studied experimentally. The mechanism responsible for two different degrees of tail erosion were identified. The optimum amplitude of a 1.1 microsec pulse for maximum energy transfer through the air was determined. Author

N91-18529# Stanford Univ., CA. Space, Telecommunications, and Radioscience Lab.

OVERVIEW OF IONOSPHERIC MODIFICATION FROM SPACE PLATFORMS Abstract Only

Peter M. Banks *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 2 p (For primary document see N91-18506 10-46)

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Spaceborne, nonelectromagnetic methods of modifying the E- and F-regions of the terrestrial ionosphere are discussed. Of these methods, the most well-understood is the direct injection of chemical vapors into the ambient medium. The first injection of barium clouds into the upper atmosphere over two decades ago has led to evolution of understanding of complex electrodynamic processes acting in the ionosphere and spawned extensive studies of small-scale plasma instabilities. Modification to the ionosphere can last for hours from such injections. Other vapors have also been released, including water vapor, SF6, and other more noxious gases, in successful efforts to alter the chemistry of the ionosphere. In another direction, injections of high amu gases from orbiting spacecraft have been made in attempts to understand the non-classical ionization processes involved in the critical ionization velocity (CIV) concept. The results seem to indicate that for CIV to act in space, large quantities of injected gas are required to achieve a minimum interaction volume density. However, in these and other experiments, it was found that the potential CIV effects are supplemented by a variety of associated classical processes also acting for these same gases. Direct modification of the ionosphere via energetic electron beams has also been undertaken from rocket and satellite platforms. Results indicate that the process of electron energy deposition is much more complex than previously thought as a consequence of the need to take into account charging of the launching platform, the retarding effects of substantial electric fields near the beam, and atmospheric scattering in the ionosphere. Other forms of ionospheric modification via ion beams, energetic neutral particle beams, x-ray sources, and MeV particle beams have also been proposed, but several of these remain to be consummated with experiments. Only the abstract and a discussion are presented. Author

N91-18530# Air Force Geophysics Lab., Hanscom AFB, MA. Space Physics Div.

PLASMA DENSITY MODIFICATIONS BY MEANS OF PULSED BEAM CIV IN THE IONOSPHERE

Shu T. Lai, William J. McNeil (RADEX, Inc., Bedford, MA.), and Edmond Murad *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 6 p (For primary document see N91-18506 10-46)

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Alven's critical ionization velocity (CIV) discharge gives rise to rapid increase in electron density. The existence of CIV has been proven in the laboratory. If CIV occurs in space, there would be important consequences. Not only would electromagnetic wave propagation be affected by the enhanced plasma density, but there would also be important implications in spacecraft contamination. In attempts to prove CIV in space, many researchers used the barium shaped charge explosion method. The results have been mostly negative with two exceptions. A modified CIV space experiment by means of a multiple pulse beam (MPB) of neutral atoms is proposed. The 'particle-in-cell' method is used to simulate CIV in a MPB under ionospheric conditions. A single or MPB neutral with seed ionization develops the modified two-stream instability which energizes the electrons. When the electrons become hot enough, they ionize the neutrals in the beam. Numerical simulation results of single and multiple pulse cases are compared, revealing the enhanced ionization for the MPB case. Author

N91-18531*# Stanford Univ., CA. Space, Telecommunications, and Radioscience Lab.

PLASMA DENSITY ENHANCEMENTS CREATED BY THE IONIZATION OF THE EARTH'S UPPER ATMOSPHERE BY ARTIFICIAL ELECTRON BEAMS

Torsten Neubert and Peter M. Banks *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 6 p (For primary document see N91-18506 10-46)

(Contracts NAS8-35350; NAGw-1566; NAG5-607; F19628-89-K-0040)

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Analytical calculations and experimental observations relating to the interaction with the Earth's upper atmosphere of electron beams emitted from low altitude spacecraft are presented. The problem is described by two coupled nonlinear differential equations in the up-going (along a magnetic field line) and down-going differential energy flux. The equations are solved numerically, using the MSIS atmospheric model and the IRI ionospheric model. The results form the model compare well with recent observations from the CHARGE 2 sounding rocket experiment. Two aspects of the beam-neutral atmosphere interaction are discussed. First, the limits on the electron beam current that can be emitted from a spacecraft without substantial spacecraft charging are investigated. This is important because the charging of the spacecraft to positive potentials limits the current and the escape energy of the beam electrons and thereby limits the ionization of the neutral atmosphere. As an example, we find from CHARGE 2 observations and from the model calculations that below about 180 km, secondary electrons generated through the ionization of the neutral atmosphere by 1 to 10 keV electron beams from sounding rockets, completely balance the beam current, thereby allowing the emission of very high beam currents. Second, the amount of plasma production in the beam-streak is discussed. Results are shown for selected values of the beam energy, spacecraft velocity, and spacecraft altitude. Author

N91-18532*# Stanford Univ., CA. Space, Telecommunications, and Radioscience Lab.

IONOSPHERIC MODIFICATION USING RELATIVISTIC ELECTRON BEAMS

Peter M. Banks, Anthony C. Fraser-Smith, and B. E. Gilchrist *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 18 p (For primary document see N91-18506 10-46)

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The recent development of comparatively small electron linear accelerators (linacs) now makes possible a new class of ionospheric modification experiments using beams of relativistic electrons. These experiments can potentially provide much new information about the interactions of natural relativistic electrons with other particles in the upper atmosphere, and it may also make possible new forms of ionization structures extending down from the lower ionosphere into the largely un-ionized upper atmosphere. The consequences of firing a pulsed 1 A, 5 Mev electron beam downwards into the upper atmosphere are investigated. If a small pitch angle with respect to the ambient geomagnetic field is selected, the beam produces a narrow column of substantial ionization extending down from the source altitude to altitudes of approximately 40 to 45 km. This column is immediately polarized by the natural middle atmosphere fair weather electric field and an increasingly large potential difference is established between the column and the surrounding atmosphere. In the regions between 40 to 60 km, this potential can amount to many tens of kilovolts and the associated electric field can be greater than the field required for breakdown and discharge. Under these conditions, it may be possible to initiate lightning discharges along the initial ionization channel.

Filamentation may also occur at the lower end to drive further currents in the partially ionized gases of the stratosphere. Such discharges would derive their energy from the earth-ionosphere electrical system and would be sustained until plasma depletion and/or electric field reduction brought the discharge under control. It is likely that this artificially-triggered lightning would produce measurable low-frequency radiation. Author

N91-18533# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Physique et Chimie de l'Environnement.

ELECTRON GYRO-HARMONICS GENERATED BY SPACEBORNE ARTIFICIAL ELECTRON BEAM

D. Mourenas and C. Beghin *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 15 p (For primary document see N91-18506 10-46)

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Results on high-frequency waves generated by the phenomena induced by charged particle beam (PICPAB) experiment flown on the Spacelab-1 shuttle mission are presented. An interpretation for the wave generation mechanism associated with such an experiment is proposed. This experiment comprised both electron and ion accelerators of a few keV installed on board the space shuttle and associated with nearby diagnostic instruments such as plasma and wave analyzers. First, the observations are compared to previous results obtained in similar conditions and they are discussed in the frame of various beam-plasma interaction models. The main features are electron cyclotron harmonics which appear modulated in amplitude with maxima occurring near the harmonics of the upper hybrid resonance. An interaction between the return flux electrons and the ambient plasma is thought to have generated the first cyclotron harmonics close to f (sub uh) and, after nonlinear saturation and trapping processes, the entire spectrum. By means of a nonlinear single-wave model, developed analytically and solved numerically, most of the experimental features are finally recovered. Author

N91-18534# Norwegian Defence Research Establishment, Kjeller.

VEHICLE CHARGING IN LOW DENSITY PLASMAS

B. N. Maehlum and J. Troim *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 11 p (For primary document see N91-18506 10-46)

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Studies of electrical charging of space vehicles have been reported in a number of papers in the last ten years. These studies are based on charging due to onboard electron and ion accelerators as well as charging due to thermal and energetic electrically charge particles impinging on the surface of the vehicle. In spite of this significant effort made in the field, both theoretically and experimentally, the vehicle charging problem is far from being completely understood. Part of the problem relates to the effects of the plasma disturbances created by the beam. Several attempts have been made with a varying degree of success to simulate space plasma processes in large plasma chambers. The celebrated studies in the large chamber at Johnson Space Center show that the plasma may be very disturbed in the presence of a beam of fast electrons by a beam plasma discharge (BDP) process. This process was expected also to explain phenomena observed in the upper atmosphere and possible various aspects of the vehicle charging. However, there are still some doubts as to whether the BDP really occurs in space, and the significance of the laboratory simulation experiments conducted in the past remains obscure. A number of high vehicle chargings generated by electron beams is presented, and how this charging depends on the characteristics of the plasma environment is discussed. Also, some results from a simulation study of these problems conducted in the NDRE plasma chamber are reviewed. Author

N91-18535*# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.

PLANNING FOR COORDINATED SPACE AND GROUND-BASED IONOSPHERIC MODIFICATION EXPERIMENTS

M. C. Lee, William J. Burke, Herbert C. Carlson, John L. Heckscher, Paul A. Kossey, E. J. Weber, and S. P. Kuo (Polytechnic Univ., Farmingdale, NY.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 8 p (For primary document see N91-18506 10-46)

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The planning and conduction of coordinated space and ground-based ionospheric modification experiments are discussed. The purpose of these experiments is to discuss: (1) the nonlinear VLF wave interaction with the ionospheric plasmas; and (2) the nonlinear propagation of VLF waves in the HF-modified ionosphere. It is expected that the HF-induced ionospheric density striations can render the nonlinear mode conversion of VLF waved into lower hybrid waves. Lower hybrid waves can also be excited parametrically by the VLF waves in the absence of the density striations if the VLF waves are intense enough. Laboratory experiments are planned for crosschecking the results obtained from the field experiments. Author

N91-18536# Centre National de la Recherche Scientifique, Orleans (France). Lab de Physique et Chimie de l'Environnement.

WAVE-PARTICLE INTERACTIONS ASSOCIATED WITH VLF TRANSMITTERS

Francois Lefeuvre *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 11 p (For primary document see N91-18506 10-46)

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Wave-particle and wave-wave interactions associated with VLF ground-based transmitters are reviewed. The topics covered include: particle precipitation, amplification and triggering of new emissions, and excitation of resonant frequencies. Author

N91-18537# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.

CAUSES AND EFFECTS OF INTERACTIONS BETWEEN ENERGETIC ELECTRONS AND WHISTLER-MODE WAVES IN THE COUPLED MAGNETOSPHERE-IONOSPHERE-ATMOSPHERE SYSTEM

M. J. Rycroft *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 9 p (For primary document see N91-18506 10-46)

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The physical mechanism of a cyclotron resonance interaction between trapped energetic electrons and whistler-mode waves in the magnetosphere is discussed. Not only do the electrons have their pitch angles reduced in this interaction, so that they may be precipitated into the upper atmosphere, but also the waves can be amplified. Such a flux of precipitating electrons can, either by direct ionization or via bremsstrahlung radiation, cause a pimple to be produced on the bottom of the ionosphere. That can significantly modify the amplitude and/or phase of very low frequency radio signals propagating in the Earth-ionosphere waveguide. Various experimental observations that demonstrate the reality of such effects are presented. Author

N91-18538# Air Force Geophysics Lab., Hanscom AFB, MA.

IONOSPHERIC HEATING FOR RADIATION BELT CONTROL

William J. Burke and Elena Villalon (Northeastern Univ., Boston, MA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct.

1990 7 p (For primary document see N91-18506 10-46)
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Pitch-angle scattering interactions of electromagnetic waves in the ELF/VLF bands with trapped electrons describe the dynamics of the freshly filled radiation belts flux tubes. The natural existence of a 'slot' region with electron fluxes below the Kennel-Petschek limit requires non-local wave sources. A set of planned, active experiments is described in which VLF radiation is injected from ground and space band transmitters in conjunction with the Combined Release and Radiation Effects Satellite in the radiation belts. These experiments can measure the intensity if waves driving pitch-angle diffusion and the electron energies in gyroresonance with the waves. Author

N91-18539# Stanford Univ., CA. STAR Lab.
MODIFICATION OF THE LOWER IONOSPHERE IN LIGHTNING-INDUCED ELECTRON PRECIPITATION EVENTS AND THROUGH VLF HEATING
Umran S. Inan *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p (For primary document see N91-18506 10-46)
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Different mechanisms by which VLF waves from ground based sources modify the nighttime lower ionosphere (D-region) are discussed. One process by which the ionosphere is regularly disturbed involves the precipitation of short bursts of energetic electrons out of the radiation belts in gyroresonant interactions with whistler waves launched by lightning discharges. A second process involves direct upward coupling of lightning electric fields to the lower ionosphere leading to intense electric fields and ionization enhancements. A third process is the heating of the lower ionosphere by upgoing VLF waves from ground based transmitters and lightning, leading to up to 100 percent increase in electron temperature at 80 to 90 km altitudes. Author

N91-18540*# Naval Research Lab., Washington, DC. Space Plasma Branch.
IONOSPHERIC CHEMICAL RELEASES
Paul A. Bernhardt and W. A. Scales *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p Sponsored by NASA, Washington (For primary document see N91-18506 10-46)
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Ionospheric plasma density irregularities can be produced by chemical releases into the upper atmosphere. F-region plasma modification occurs by: (1) chemically enhancing the electron number density; (2) chemically reducing the electron population; or (3) physically convecting the plasma from one region to another. The three processes (production, loss, and transport) determine the effectiveness of ionospheric chemical releases in subtle and surprising ways. Initially, a chemical release produces a localized change in plasma density. Subsequent processes, however, can lead to enhanced transport in chemically modified regions. Ionospheric modifications by chemical releases excites artificial enhancements in airglow intensities by exothermic chemical reactions between the newly created plasma species. Numerical models were developed to describe the creation and evolution of large scale density irregularities and airglow clouds generated by artificial means. Experimental data compares favorably with theses models. It was found that chemical releases produce transient, large amplitude perturbations in electron density which can evolve into fine scale irregularities via nonlinear transport properties. Author

N91-18541# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Lab. de Detection et de Geophysique.
OBSERVATIONS OF PERTURBATIONS PRODUCED BY POWERFUL CHEMICAL EXPLOSIONS IN THE IONOSPHERE [OBSERVATIONS DE PERTURBATIONS PRODUITES PAR DES EXPLOSIONS CHIMIQUES PUISSANTES DANS L'IONOSPHERE]
Elisabeth Blanc and Abram R. Jacobson (Los Alamos National Lab., NM.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p In FRENCH; ENGLISH summary (For primary document see N91-18506 10-46)
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Observations by HF ionospheric sounding of disturbances produced by powerful chemical explosions (several KT) are described. These experiments were performed at distances of about 30 to 40 km from the explosion point. Because of the amplification due to the atmospheric density decrease with increasing altitude, the acoustic waves from such explosions are characterized by shock waves features when they reach the ionosphere. The development of the disturbance was studied from the lower E region up to the F2 region by using 8 sounding frequencies. It is shown that a blanketing sporadic E layer undergoes small scale fluctuations and becomes semi-transparent after the passage of the disturbance. Several wave fronts with different properties are followed to the F1 region. In the lower E region, the wave induced stratifications on which the radio waves are partially reflected. The echoes totally reflected in the E region undergo an amplitude modulation with a period of about 2 seconds, persisting about 30 minutes. The variations of the total reflection height and of the Doppler frequency shift are most noticeable in the F1 region. The wave loses its shock wave feature in the F2 region and the disturbance signature is then that of a pseudo-sinusoidal wave with a wave length of several tens of kilometers. Author

N91-18542# Naval Research Lab., Washington, DC. Space Plasma Branch.
LABORATORY SIMULATION OF HIGH-ALTITUDE DISRUPTIVE EFFECTS
Barrett H. Ripin, J. Grun, C. K. Manka, J. A. Stamper, E. A. McLean, J. Resnick, R. Burris, J. Crawford, J. D. Huba, and G. Ganguli *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p Sponsored in part by ONR and DNA (For primary document see N91-18506 10-46)
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Disturbed ionospheric and space conditions are simulated and studied with laser-produced plasmas. Intense laser pulses produce plasma energy densities, comparable to those occurring in nuclear detonations. The expansion of these plasmas through a background ambient magnetized plasma simulate high-altitude nuclear explosion effects, as well as supernova shock and other energetic space plasma conditions. Some effects, such as blast-waves and plasma instabilities leading to non-uniform and disturbed space environments that can affect space-based communications and sensor systems, are discussed. The laser experiment is useful for investigation of mechanisms accompanying less energetic active space experiments also, such as chemical releases and particle beam injections. Author

N91-18543# Hamburg Univ. (Germany, F.R.). Meteorological Inst.
MODIFICATION OF TROPOSPHERIC PROPAGATION CONDITIONS
H. Jeske *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct.

1990 11 p (For primary document see N91-18506 10-46)
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The propagation mechanisms of ultra-short radio waves and microwaves are governed by the composition of the troposphere and their space-time structure of the refractive index field. Useful effects are obtained by chaff clouds concerning communication channels, masking of targets or meteorological research. A wide field of posiibilities seems to be within the scope of weather modification experiments. But due to the huge variability of cloud and rain parameters only minor propagation changes are to be expected. A successful application of remotely determining atmospheric temperature profiles is the modulation of the atmospheric refractive index field by sound waves and tracking the acoustic wave fronts by a Doppler radar (Radio Acoustic Sounding System). Oil and alga slicks on water surfaces may change the reflection/scattering and emission properties for radar waves. They also suppress evaporation which may influence the development of tropical storms but just so evaporation duct propagation of microwaves. Author

N91-18544# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (Germany, F.R.).
IONOSPHERIC MODIFICATION AND IMAGINABLE SYSTEM APPLICATIONS
H. J. Albrecht *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 18 p (For primary document see N91-18506 10-46)
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The nowadays predominant areas of imaginable system applications of anthropogenic modifications applied to the ionosphere are reviewed. Relevant conditions are indicated, such as the natural systems environment, areas of possible modifications, and aspects of compatibility and interference. Resultant criteria of applications to systems and required support measures are also discussed. Author

N91-18545# ARCO Power Technologies, Inc., Washington, DC.
ARTIFICIAL IONOSPHERIC MIRRORS FOR RADAR APPLICATIONS
Robert D. Short, Tom Wallace, Clayton V. Stewart, Pierre Lallement, and Peter Koert *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 12 p (For primary document see N91-18506 10-46)
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Recognition of performance limitations associated with traditional skywave over-the-horizon (OTH) HF radars has led a number of investigators to propose the creation of an Artificial Ionospheric Mirror (AIM) in the upper atmosphere, in order to reflect ground-based radar signals for OTH surveillance. The AIM is produced by beaming sufficient electromagnetic power to the lower ionosphere (around 70 km) to enhance the in situ ionization level to 10(exp 7) to 10(exp 8) electrons/cu cm, thereby providing an ionized layer capable of reflecting radar frequencies of 5 to 90 MHz. A baseline AIM system concept and an associated performance evaluation are presented, based upon the relevant ionization and propagation physics and in the context of air surveillance for the cruise missile threat. Results of the subject indicate that a system using this concept would both complement and enhance the performance of the existing skywave OTH radars. Author

N91-18546# ARCO Power Technologies, Inc., Washington, DC.
ELECTROJET MODULATION ELF COMMUNICATIONS
K. Papadopoulos (Maryland Univ., College Park.), Ramy A. Shanny, L. Susman, M. Machina, and P. Stamboulis *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 9 p Sponsored in part by DARPA and ONR (For primary document see N91-18506 10-46)
Copyright Avail: NTIS HC/MF A21; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The causes fir the inefficient conversion of HF to ELF waves by ionospheric heating observed in recent experiments are examined. It is found that for the low frequency HF range 2.5 to 4 MHz used in the present experiments the modified conductance saturates during a fraction of the HF irradiation cycle. As a result most of the HF energy is transferred to processes that do not affect the conductance significantly. This was confirmed experimentally. Techniques relying on fast HF antenna sweeping by which the efficiency can increase by more than two orders of magnitude are presented. Author

N91-18547# Pennsylvania State Univ., University Park. Communications and Space Sciences Lab.
INVESTIGATION OF THE POLAR ELECTROJET CURRENT SYSTEM USING RADIO WAVE HEATING FROM A GROUND-BASED FACILITY
D. H. Werner, A. J. Ferraro, and Richard G. Brandt (Office of Naval Research, Arlington, VA.) *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 13 p (For primary document see N91-18506 10-46)
Copyright Avail: NTIS HC/MF A21; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The High Power Auroral Stimulation (HIPAS) heating facility was used to modulate D region ionospheric currents at high latitudes, producing very low frequency (VLF) radio wave emission. The behavior of these ionospheric currents can be deduced from a comprehensive study of the VLF signals received at a local field site. The relationship is examined between the VLF magnetic field strength measured on the ground and the intensity of an overhead electrojet current for the purpose of enhancing communications. The mapping of the polar electrojet current is investigated. A finite difference solution to the electrojet mapping problem is presented. The obtained results are also presented and discussed. A promising new diagnostic technique for studying ionospheric D region currents was implemented. This technique involves high frequency beam steering for localized VLF generation in the mapped region below electrojets. Beam steering was used to estimate the strength and current distribution of the polar electrojet, and for charting the movements of overhead currents. Author

N91-18548# Rice Univ., Houston, TX. Dept. of Space Physics and Astronomy.
THE GENERATION OF ULF WAVES IN THE IONOSPHERE
S. T. Noble and William E. Gordon *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 4 p (For primary document see N91-18506 10-46)
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One explanation for the generation of HF sidebands during two-frequency heating experiments is based on the interaction between the beat frequency wave and the HF waves. To test this, simultaneous HF sideband and ULF measurements were made. The ULF measurement technique and recent findings are discussed. At the core of the ULF receiving system are three mutually perpendicular magnetometer sensors. For most studies, only the band 0.5 to 20 Hz is utilized. Although based upon a limited data set, underdense heating has yielded no signs of ULF production in the ionosphere. Although HF swelling near the reflection height can amplify the fields significantly during overdense heating, no signs of ULF were observed at these times either. Author

N91-18549# Los Alamos National Lab., NM. Atmospheric Sciences Div.
HF PROPAGATION THROUGH ACTIVELY MODIFIED IONOSPHERES: MODELLING AND EXPERIMENTAL RESULTS
Paul E. Argo, T. Joseph Fitzgerald, John H. Wolcott, and David J.

Simons *In* AGARD, Ionospheric Modification and its Potential to Enhance or Degrade the Performance of Military Systems Oct. 1990 10 p Sponsored in part by DOE (For primary document see N91-18506 10-46)
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A computer modelling capability was developed for predicting the effects of localized electron density perturbations created by ionospheric chemical releases upon oblique, one-hop HF propagation paths. A three-dimensional description of the depleted or enhanced ionization, including formation, evolution, and drift are presented. The code uses a homing ray tracing technique to calculate the energy propagation paths through the modified ionosphere and hence can predict multipath effects. Author

N91-18550*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A COMPARISON OF GROUND-BASED AND SPACE FLIGHT DATA: ATOMIC OXYGEN REACTIONS WITH BORON NITRIDE AND SILICON NITRIDE
J. B. Cross, E. H. Lan, C. A. Smith, W. J. Whatley (Sparta, Inc., Huntsville, AL.), and S. L. Koontz 1990 7 p Presented at the Air Force Workshop on Surface Reactions in the Space Environment, Evanston, IL, 24-25 Sep. 1990
(Contract W-7405-eng-36)
(NASA-TM-103385; NAS 1.15:103385; DE91-004856; LA-UR-90-3968; CONF-9009307-1) Avail: NTIS HC/MF A02 CSCL 04A

The effects of atomic oxygen on boron nitride (BN) and silicon nitride (Si3N4) have been studied in low Earth orbit (LEO) flight experiments and in a ground-based simulation facility at Los Alamos National Laboratory. Both the in-flight and ground-based experiments employed the materials coated over thin (approx 250 Angstrom) silver films whose electrical resistance was measured in situ to detect penetration of atomic oxygen through the BN and Si3N4 materials. In the presence of atomic oxygen, silver oxidizes to form silver oxide, which has a much higher electrical resistance than pure silver. Permeation of atomic oxygen through BN, as indicated by an increase in the electrical resistance of the silver underneath, was observed in both the in-flight and ground-based experiments. In contrast, no permeation of atomic oxygen through Si3N4 was observed in either the in-flight or ground-based experiments. The ground-based results show good qualitative correlation with the LEO flight results, thus validating the simulation fidelity of the ground-based facility in terms of reproducing LEO flight results. DOE

N91-18551*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
BASIC RESEARCH FOR THE GEODYNAMICS PROGRAM
Semiannual Status Report No. 25, Jul. - Dec. 1990
Jan. 1991 31 p
(Grant NsG-5265; OSURF Proj. 711055)
(NASA-CR-187959; NAS 1.26:187959) Avail: NTIS HC/MF A03 CSCL 08E

The mathematical models of space very long base interferometry (VLBI) observables suitable for least squares covariance analysis were derived and estimatability problems inherent in the space VLBI system were explored, including a detailed rank defect analysis and sensitivity analysis. An important aim is to carry out a comparative analysis of the mathematical models of the ground-based VLBI and space VLBI observables in order to describe the background in detail. Computer programs were developed in order to check the relations, assess errors, and analyze sensitivity. In order to investigate the estimatability of different geodetic and geodynamic parameters from the space VLBI observables, the mathematical models for time delay and time delay rate observables of space VLBI were analytically derived along with the partial derivatives with respect to the parameters. Rank defect analysis was carried out both by analytical and numerical testing of linear dependencies between the columns of the normal matrix thus formed. Definite conclusions were formed about the rank defects in the system. Author

N91-18552*# Lawrence Livermore National Lab., CA. Atmospheric and Geophysical Sciences Div.
SOLAR VARIATIONS AND THEIR INFLUENCE ON TRENDS IN UPPER STRATOSPHERIC OZONE AND TEMPERATURE
Donald J. Wuebbles, Douglas E. Kinnison, and Judith L. Lean (Naval Research Lab., Washington, DC.) Oct. 1990 8 p Presented at the 71st Annual Meeting of American Meteorological Society, New Orleans, LA, 13-18 Jan. 1991 Submitted for publication Sponsored by NASA, Washington
(Contract W-7405-eng-48)
(NASA-CR-187999; NAS 1.26:187999; DE91-007132; UCRL-JC-106108; CONF-910143-4) Avail: NTIS HC/MF A02 CSCL 04A

Over the past decade, knowledge of the magnitude and temporal structure of the variations in the sun's ultraviolet irradiance has increased steadily. A number of theoretical modeling studies have shown that changes in the solar ultraviolet flux during the 11-year solar cycle can have a significant effect on stratospheric ozone concentrations. With the exception of Brasseur et al., who examined a very broad range of solar flux variations, all of these studies assumed much larger changes in the ultraviolet flux than measurements now indicate. These studies either calculated the steady-state effect at solar maximum and solar minimum or assumed sinusoidal variations in the solar flux changes with time. It is now possible to narrow the uncertainty range of the expected effects on upper stratospheric ozone and temperature resulting from the 11-year solar cycle. A more accurate representation of the solar flux changes with time is used in this analysis, as compared to previous published studies. This study also evaluates the relative roles of solar flux variations and increasing concentrations of long-lived trace gases in determining the observed trends in upper stratospheric ozone and temperature. The Lawrence Livermore National Laboratory (LLNL) two-dimensional chemical-radiative-transport model of the global atmosphere is used to evaluate the combined effects on the stratosphere from changes in solar ultraviolet irradiances and trace gas concentrations over the last several decades. Derived trends in upper stratospheric ozone concentrations and temperature are then compared with available analyses of ground-based and satellite measurements over this time period. DOE

N91-18553# National Oceanic and Atmospheric Administration, Washington, DC.
A COMPARISON OF ERBE AND AVHRR LONGWAVE FLUX ESTIMATES
Arnold Gruber, Philip Ardanuy, Mitchell Weiss, S. K. Yang, Robert G. Ellingson, and Sung Nam Oh (Maryland Univ., College Park.) Nov. 1990 95 p
(NOAA-TR-NESDIS-50) Avail: NTIS HC/MF A05

Comparisons were made between estimates of the outgoing longwave radiation at the top of the atmosphere derived from narrowband advanced very high resolution radiometer (AVHRR) and broadband earth radiation budget experiment (ERBE) scanning instruments. Four months of measurements are considered: April, July, and October, 1985 and January 1986. Two types of comparisons are considered: instantaneous and monthly averaged. In the former, regional, zonal, and global analyses are performed using collocated and coincident outgoing longwave radiation (OLR) estimates on a 2.5 degree latitude/longitude scale. In general, the two data sets are found to be in reasonable good agreement, with the mean state and fundamental variability in time and space captured by the two sets of measurements. However, systematic biases are observed between the two data sets, particularly over the subtropical oceans, the daytime deserts, and over snow-covered surfaces at the high latitudes. The monthly global bias between the two data sets (ERBE minus AVHRR) is between -1 and 2 W/sq m during daytime and between 4 to 7 w/sq m during nighttime, while the RMS differences range between 12(June) and 15(January) W/sq m. In the comparison of the monthly averaged fields, very good agreement is found in the large-scale patterns, while certain different characteristics are revealed. In general, ERBE overestimates AVHRR by about 4 W/sp m with an RMS difference of 5 W/sq m to 8 W/sq m. The

relationship between the two data sets appears to be dependent on the surface geography and season. Possible reasons for the differences are discussed. Author

N91-18974*# Stanford Univ., CA. Dept. of Electrical Engineering.
A SATELLITE-GROUND STUDY OF THE DYNAMICS OF THE BULGE REGION OF THE EARTH'S MAGNETOSPHERE
Donald L. Carpenter *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 3 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 04A

N91-18990*# Alabama A & M Univ., Normal. Dept. of Food Science and Animal Industries.
A GRAVITATIONAL TEST OF WAVE REINFORCEMENT VERSUS FLUID DENSITY MODELS
Jacqueline Umstead Johnson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 08G

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N91-18554# National Academy of Sciences - National Research Council, Washington, DC. Committee on Haze in National Parks and Wilderness Areas.
HAZE IN THE GRAND CANYON: AN EVALUATION OF THE WINTER HAZE INTENSIVE TRACER EXPERIMENT
1990 109 p
(Contracts DI-14-01-0001-89-C-39; DE-FG01-90FE-62072; VN-08016CAS)
(ISBN-0-309-04341-7; LC-90-62765) Avail: NTIS HC/MF A06

The Committee on Haze in National Parks and Wilderness Areas presents their evaluation of the National Park Service's (NPS's) study on the winter haze intensive tracer experiment (WHITEX) and the NPS's conclusion that the Navajo Generating Station (NGS) contributed to wintertime visibility impairment in Grand Canyon National Park during the study. Some of the topics covered include: (1) the committee, its charge, and its approach; (2) the committee's specific interpretation of its charge; (3) a WHITEX overview; (4) WHITEX source-attribution models; (5) critical aspects of WHITEX techniques and design; (6) limitations of the WHITEX study; and (7) the committee's conclusions in perspective. K.S.

N91-18555# Air Force Geophysics Lab., Hanscom AFB, MA.
INVESTIGATION OF THE PREDICTION OF LIGHTNING STRIKES USING NEURAL NETWORKS
Arnold A. Barnes, Jr. and Donald S. Frankel (KTAADN, Inc., Newton, MA.) 11 Oct. 1990 8 p Presented at the 28th AIAA Aerospace Science Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-19873
(AD-A229042; GL-TR-90-0269; AIAA-PAPER-90-0484) Avail: NTIS HC/MF A02 CSCL 04/2

A neural network is being trained to predict lightning at Cape Canaveral for periods up to two hours in advance. Inputs consists of ground based field mill data, meteorological tower data, lightning location data and radiosonde and rapid changes in the field mill data, offset in time, provide the forecasts or desired output values used to train the neural network through backpropagation. Examples of input data are shown and an example of data compression using a hidden layer in the neural network is discussed. GRA

N91-18556# Lawrence Livermore National Lab., CA.
ANALYSIS OF METEOROLOGICAL DATA FROM THREE SITES IN THE NORTHEASTERN UNITED STATES FOR APPLICATION OF EPA AIRDOS CODE
Frank Gouveia Nov. 1990 58 p
(Contract W-7405-eng-48)
(DE91-004982; UCRL-ID-104988) Avail: NTIS HC/MF A04

Meteorological data for the entire year of 1989 were collected at three sites that comprise the Knolls Atomic Power Laboratory: Knolls site, Kesselring site, and Windsor site. These data are 15-min averages of wind speed, wind direction, standard deviation of wind direction, and temperature. Hourly averages were computed and used for all analysis. The Pasquill stability category was computed using procedures established by the Environmental Protection Agency. Joint frequency of wind speed, direction, and stability were computed and displayed as wind roses for each stability. The joint frequency tables are presented in the form that is appropriate as meteorological input for the AIRDOS-EPA dispersion model. DOE

N91-18557# Lawrence Livermore National Lab., CA. Atmospheric and Geophysical Sciences Div.
INTERSEASONAL AIR-SEA INTERACTIONS IN THE OSU (OREGON STATE UNIVERSITY) COUPLED UPPER OCEAN-ATMOSPHERE GCM (GENERAL CIRCULATION MODEL)
K. R. Sperber, W. L. Gates, G. L. Potter, and S. Hameed (State Univ. of New York, Stony Brook.) Nov. 1990 7 p Presented at the 15th Annual Climate Diagnostics Workshop, Asheville, NC, 19 Oct. - 2 Nov. 1990
(Contracts W-7405-eng-48; DE-FG02-85ER-60314)
(DE91-005261; UCRL-JC-105562; CONF-9010277-1) Avail: NTIS HC/MF A02

The climatology of some variables which play an important role in the generation of low frequency variability in the Oregon State University coupled upper ocean-atmosphere general circulation model (GCM) is examined. The atmospheric model, representing the troposphere, consists of two equal mass layers between the surface and 200 mb. The ocean model, developed by Pollard (1982), consists of two variable depth layers crudely representing the mixed layer and thermocline which overlie deep quiescent water. Entrainment between the upper two layers is parameterized according to the turbulent kinetic energy budget method of Niiler and Kraus (1977). Both ocean and atmospheric GCMs have a resolution of four degrees in latitude and five degrees in longitude. The interseasonal variation of thermocline depth (sum of the two variable depth upper layers), mixed layer currents, and surface winds from the last 23 years of a 25-year control integration of this coupled model are examined. DOE

N91-18558*# Stockholm Univ. (Sweden). Dept. of Meteorology.
ATMOSPHERIC WATER PARAMETERS IN MID-LATITUDE CYCLONES OBSERVED BY MICROWAVE RADIOMETRY AND COMPARED TO MODEL CALCULATIONS
Kristina B. Katsaros, Ulla Hammarstrand, and Grant W. Petty Oct. 1990 30 p Sponsored in part by Swedish National Science Research Council Original contains color illustrations
(Grant NAG5-943)
(NASA-CR-187996; NAS 1.26:187996; DM-52; ISSN-0349-0467; ETN-91-98623) Avail: NTIS HC/MF A03; 1 functional color page CSCL 04B

Existing and experimental algorithms for various parameters of atmospheric water content such as integrated water vapor, cloud water, precipitation, are used to examine the distribution of these quantities in mid latitude cyclones. The data was obtained from signals given by the special sensor microwave/imager (SSM/I) and compared with data from the nimbus scanning multichannel microwave radiometer (SMMR) for North Atlantic cyclones. The potential of microwave remote sensing for enhancing knowledge of the horizontal structure of these storms and to aid the development and testing of the cloud and precipitation aspects of limited area numerical models of cyclonic storms is investigated. ESA

N91-18559# Stockholm Univ. (Sweden). Dept. of Meteorology.
ON APPLYING THE ADJOINT MODEL TECHNIQUE TO A TIME SERIES OF SURFACE PRESSURE DATA

Stefan Gollvik (Swedish Meteorological and Hydrological Inst., Norkoeping.) Oct. 1990 30 p Sponsored by Swedish Meteorological and Hydrological Inst., Norrkoeping, Sweden
(DM-53; ISSN-0349-0467; ETN-91-98624) Avail: NTIS HC/MF A03

An adiabatic, mixed layer, shallow water system for the mesobeta scale deviations from a prescribed time dependent larger scale flow is used for data assimilation studies. The adjoint model technique is used, where the cost junction contains information for mass field data only, and the boundary layer winds are derived. Experiments performed using mesobeta scale pressure analyses and synoptic station pressure data are described. The winds produced showed no typical response to orographic forcing. It seems that a weak correlation exists in the vorticity field between the data assimilation produced and the observations. ESA

N91-18560*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
DEVELOPMENT AND APPLICATION OF A TIME-SPACE CONVERSION TECHNIQUE FOR ANALYSIS OF WEATHER SYSTEMS PASSING OVER THE KENNEDY SPACE CENTER Final Report
Gregory S. Forbes Feb. 1991 123 p
(Grant NAG8-754)
(NASA-CR-187967; NAS 1.26:187967) Avail: NTIS HC/MF A06 CSCL 04B

A procedure for using asynchronous data to generate spatial analyses for a single time is described. This procedure, called a time-space-conversion scheme, involves a separation of individual observation into a perturbation component and a mean component. When this separation is done for numerous sites, and the data are plotted on a map and analyzed, it can be seen that the temporal-mean data relate to the large-scale conditions over the region. Because some of the perturbations measured over Florida and near the Gulf Coast and East Coast States become displaced over data-sparse oceanic regions, it became necessary to devise a method for determining temporal means over the offshore areas. This was done by using analyses from the nested grid model (NGM) run twice daily at the National Meteorological Center. Pseudo-soundings were constructed from these analyses at an array of oceanic locations, and used to construct the temporal mean fields offshore. Similarly, in the event that measured data were not available at some levels and times at rawinsonde, jimsphere, or profiler sites, the missing data were replaced with NGM analysis data for purposes of computing the temporal means at these sites. A case study from December 2, 1988 is used to illustrate the results of the time-space-conversion scheme. Analyses are shown for the period from 1400 to 1800 UTC, which covers the launch of the Space Shuttle (STS27), and reveal that a well-defined jet stream and upper-level front were situated over KSC at this time. Embedded within the jet stream were patches of strong vertical wind shear and low Richardson numbers, indicating a considerable risk of the presence of clear-air turbulence. Author

N91-18561*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A REVIEW OF RECENT RESEARCH ON IMPROVEMENT OF PHYSICAL PARAMETERIZATIONS IN THE GLA GCM
Y. C. Sud and G. K. Walker (Centel Federal Services Corp., Greenbelt, MD.) Washington Dec. 1990 68 p Presented at the Indo-US Seminar on Parameterization of Subgrid Scale Processes in Dynamic Models of Medium-Range Prediction and Global Climate, 6-10 Aug. 1990 Sponsored by NASA, Washington
(NASA-TM-100771; REPT-91B00042; NAS 1.15:100771) Avail: NTIS HC/MF A04 CSCL 04B

A systematic assessment of the effect of a series of improvements in physical parameterizations of the Goddard Laboratory for Atmospheres (GLA) general circulation model (GCM) are summarized. The implementation of the Simple Biosphere Model (SiB) in the GCM is followed by a comparison of SiB GCM simulations with that of the earlier slab soil hydrology GCM (SSH-GCM) simulations. In the Sahelian context, the biogeophysical component of desertification was analyzed for SiB-GCM simulations. Cumulus parameterization is found to be the primary determinant of the organization of the simulated tropical rainfall of the GLA GCM using Arakawa-Schubert cumulus parameterization. A comparison of model simulations with station data revealed excessive shortwave radiation accompanied by excessive drying and heating to the land. The perpetual July simulations with and without interactive soil moisture shows that 30 to 40 day oscillations may be a natural mode of the simulated earth atmosphere system. Author

N91-18562 Royal Netherlands Meteorological Inst., The Hague.
[ACTIVITIES REPORT OF THE ROYAL NETHERLANDS METEOROLOGICAL INSTITUTE] Annual Report, 1989 [KONINKLIJK NEDERLANDS METEOROLOGISCH INSTITUT, JAARVERSLAG 1989]
Aug. 1990 28 p In DUTCH Original contains color illustrations
(ETN-91-98771) Copyright Avail: Royal Netherlands Meteorological Institute, Postbus 201, 3730 AE De Bilt, Netherlands

Climate scenarios were developed to study the consequences of changes in the atmospheric composition. Specific processes in the atmosphere, and the predictability of the correlation between the present and future status of the atmosphere were studied. The renovation of the climatological measuring network is described. Meteorological models were developed. Pollution transport was studied. Remote sensing data of the North Sea from meteorological satellites was analyzed. ESA

N91-18563# Winand Staring Centre, Wageningen (Netherlands).
ESTIMATION OF RAINFALL IN ZAMBIA USING METEOSAT-TIR DATA
J. Huygen 1989 63 p Sponsored by Beleidscomissie Remote Sensing, Delft, Netherlands
(REPT-12; ISSN-0924-3062; ETN-91-98776) Copyright Avail: NTIS HC/MF A04

The results of investigations on the development and validation of algorithms to map rainfall with METEOSAT TIR (Thermal Infra Red) data in Zambia are presented. They indicate that it is not possible to apply simple linear relationships to relate the duration of cold cloud top, as obtained with METEOSAT, to dekadic rainfall. The coefficients of these relationships are time dependent, so similar validation and calibration studies are to be continued for the approach to achieve full operational status. ESA

N91-18564# Sandia National Labs., Albuquerque, NM.
THE SANDIA TRANSPORTABLE TRIGGERED LIGHTNING INSTRUMENTATION FACILITY
G. H. Schnetzer and R. J. Fisher 1991 9 p Presented at the 1991 International Conference on Lightning and Static Electricity, Cocoa Beach, 16-19 Apr. 1991
(Contract DE-AC04-76DP-00789)
(DE91-006776; SAND-90-2253C; CONF-9104163-2) Avail: NTIS HC/MF A02

Development of the Sandia Transportable Triggered Lightning Instrumentation Facility (SATTLIF) was motivated by a requirement for the in situ testing of munitions storage bunker. Transfer functions relating the incident flash currents to voltages, currents, and electromagnetic field values throughout the structure will be obtained for use in refining and validating a lightning response computer model of this type of structure. A preliminary shakedown trial of the facility under actual operational conditions was performed during the summer of 1990 at the Kennedy Space Center's (KSC) rocket-triggered lightning test site in Florida. A description is given of the SATTLIF, which is readily transportable on a single flatbed truck or by aircraft, and its instrumentation for measuring incident lightning channel currents and the responses of systems under test. Measurements of return-stroke current peaks obtained with the SATLLIF are presented. Agreement with data acquired on the same flashes with existing KSC instrumentation is, on average, to within approximately 7 percent. Continuing currents were measured

with a resolution of approximately 2.5 A. This field trial demonstrated the practicality of using a transportable triggered lightning facility for specialized test applications. DOE

N91-18565# Sandia National Labs., Albuquerque, NM.
DAMAGE TO METALLIC SAMPLES PRODUCED BY MEASURED LIGHTNING CURRENTS
R. J. Fisher and G. H. Schnetzer 1991 10 p Presented at the 1991 International Conference on Lightning and Static Electricity, Cocoa Beach, 16-19 Apr. 1991
(Contract DE-AC04-76DP-00789)
(DE91-006777; SAND-90-2252C; CONF-9104163-1) Avail: NTIS HC/MF A02

A total of 10 samples disks of 2024-T3 aluminum and 4130 ferrous steel were exposed to rocket-triggered lightning currents at the Kennedy Space Center test site in Florida during the summer of 1990. The experimental configuration was arranged so that the samples were not exposed to the preliminary streamer, wire-burn, or following currents that are associated with an upward-initiated rocket-triggered flash but which are atypical of naturally initiated lightning. Return-stroke currents and continuing currents actually attaching to the sample were measured, augmented by close-up video recordings of approximately 3 feet of the channel above the sample and by 16-mm movies with 5-ms resolution. From these data it was possible to correlate individual damage spots with streamer, return-stroke, and continuing currents that produced them. Substantial penetration of 80-mil aluminum was produced by a continuing current of submedian amplitude and duration, and full penetration of a 35-mil steel sample occurred under an eightieth percentile continuing current. The primary purpose of the data acquired in these experiments is for use in improving and quantifying the fidelity of laboratory simulations of lighting burnthrough. DOE

N91-18566# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
NEW LIGHTNING PROGRESSION AND STRIKING DISTANCE MODEL
Y. Aihara and T. Shindo May 1990 28 p In JAPANESE; ENGLISH summary
(DE91-736787; CRIE-T-89066) Avail: NTIS HC/MF A03

A new model and the calculating method to final striking distance (gamma sub s) at the lightning strokes to the ground were studied. Gamma(sub s) is the length of unbridging length just before the stepped leader extending from thunderclouds approaches to the ground and finally completes the lightning. The minimum value of gamma(sub s) can be obtained when remaining gap space from the peak of corona sheath around the stepped leader coincides with the minimum of step length. On the basis of this model, lightning was observed and gamma(sub s) was derived as the function of lightning current from this experiment. The upper and lower limits of calculations can phenomenally explain the large variation obtained by the previously proposed formulae. Lightning distance to high structures changes at the range of 1.03 to 1.34 compared with that to the ground. This model can deal quantitatively and qualitatively with many kinds of discharging parameter from the leader progressing to lightning occurrence. DOE

N91-18971*# Niagra Univ., New York, NY. Dept. of Computer and Information Sciences.
LIGHTNING OBSERVATIONS FROM SPACE SHUTTLE
William L. Boeck *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 04B

N91-19003*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.
ANALYTICAL STUDY OF THE EFFECTS OF CLOUDS ON THE LIGHT PRODUCED BY LIGHTNING
Dieudonne D. Phanord *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 9 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N91-18567# Delaware Univ., Newark. Dept. of Mathematical Sciences.
AN APPROXIMATION SCHEME FOR THE THREE-DIMENSIONAL SCATTERED WAVE AND ITS PROPAGATING FAR-FIELD PATTERN IN A FINITE DEPTH OCEAN
Robert P. Gilbert, Yongzhi Xu, and Peter Thejll Oct. 1989 43 p
(Grant NA86AA-D-SG040)
(PB90-151002; DEL-SG-30-89) Avail: NTIS HC/MF A03 CSCL 08C

An efficient numerical scheme is described to compute the far field generated by scattering a generalized plane wave off an arbitrary submersible. The scheme is based on an approach by Colton and Monk for similar problems using radar in space. The index of refraction depends on depth and perhaps also on range. The domain is not all of space but an irregular slab. In the first approach they shall concentrate on an ocean which is a slab of thickness h, and has a constant index of refraction, as the most disturbing aspect of the problem appears to be the way the ocean surface interfere with the propagation of sound. Author

51 LIFE SCIENCES (GENERAL)

N91-18568# Princeton Univ., NJ. Dept. of Physics.
DEVELOPMENT AND APPLICATION OF PHOTOSENSITIVE DEVICE SYSTEMS TO STUDIES OF BIOLOGICAL AND ORGANIC MATERIALS Progress Report No. 1, 1 Jan. - 31 Dec. 1990
Sol M. Gruner and George T. Reynolds 12 Jul. 1990 22 p
(Contract DE-FG02-87ER-60522)
(DE91-005130; DOE/ER-60522/4) Avail: NTIS HC/MF A03

This report discusses the following basic research accomplishments: new x ray structure determination methods were developed and applied to biomembrane lipid phases; a novel mechanism for general anesthesia was proposed; the elastic properties of membranes were investigated, both theoretically and experimentally; the effects of high pressures on membranes were studied; neutron diffraction was used to probe mesophase structure; and novel lipid and surfactant systems are characterized. Also discussed are instrumentation accomplishments. DOE

N91-18569# Argonne National Lab., IL. Chemistry Div.
AN EXTENDED MODEL FOR ELECTRON SPIN POLARIZATION IN PHOTOSYNTHETIC BACTERIA
Andrea L. Morris, James R. Norris (Chicago Univ., IL.), and Marion C. Thurnauer 1990 14 p Presented at the 2nd Feldafing International Workshop, Feldafing, Fed. Republic of Germany, 24-27 Mar. 1990
(Contract W-31-109-eng-38)
(DE91-006091; CONF-9003209-2) Avail: NTIS HC/MF A03

We have developed a general model for electron spin polarization which includes contributions from both CIDEP (chemically induced dynamic electron polarization) and CRP (correlated radical polarization). In this paper, we apply this model to sequential electron transfer in photosynthetic bacteria. Our model calculates the density matrix for the P(sup +)I(sup minus) radical

pair and transfers the polarization as it develops to the P(sup +)Q(sup minus) radical pair. We illustrate several possible cases. One case is equivalent to CIDEP; no interactions are included on the secondary radical pair, P(sup +)Q(sup minus). Another approximates CRPP by either increasing the transfer rate from P(sup +)I(sup minus) to P(sup +)Q(sup minus) or restricting interactions to the secondary radical pair, P(sup +)Q(sup minus). Others allow interactions on both the primary and secondary radical pairs with various transfer rates. DOE

N91-18570# Brandeis Univ., Waltham, MA.
CARBON AND HYDROGEN METABOLISM OF GREEN ALGAE IN LIGHT AND DARK Progress Report
1990 5 p
(Contract DE-FG02-86ER-13486)
(DE91-006542; DOE/ER-13486/5) Avail: NTIS HC/MF A01

The focus of this project was the elucidation of anaerobic metabolism in ecuaryotic green algae, chlamydomonas reinhardii. Chlamydomonas is a versatile organism that can grow under disparate conditions such as fresh water lakes and sewage ponds. The cell photoassimilates CO2 aerobically and anaerobically, the latter after adaptation to a hydrogen metabolism. It can recall the knallgas or oxyhydrogen reaction and utilize hydrogen the simplest of all reducing agents for the dark assimilation of CO2 by the photosynthetic carbon reduction cycle. The dark reduction with hydrogen lies on the border line between autotrophic and heterotrophic carbon assimilation. Both autotrophic and heterotrophic bacteria are known in which molecular hydrogen can replace either inorganic or organic hydrogen donors. Here the dark reduction of CO2 acquires a particular importance since it occurs in the same cell that carries on photoreduction and photosynthesis. It is demonstrated that the algae chloroplast possesses a respiratory capacity. It seems likely that Chlamydomonas may have retained the chloroplastic respiratory pathway because of the selective advantage provided to the algae under a wide range of environmental conditions that the cells experience in nature. The ability to cycle electrons and poise the reduction level of the photosynthetic apparatus under aerobic and microaerobic conditions could allow more efficient CO2 fixation and enhanced growth under unfavorable conditions or survival under more severe conditions. DOE

N91-18571# Clemson Univ., SC. Dept. of Biological Sciences.
THE MAGNESIUM CHELATION STEP IN CHLOROPHYLL BIOSYNTHESIS
Jon Weinstein Nov. 1990 8 p
(Contracts DE-FG09-89ER-13989; DE-FG09-87ER-13768)
(DE91-006619; DOE/ER-13989/2) Avail: NTIS HC/MF A02

In photosynthetic organisms, the biogenesis of energy transducing membranes requires the coordinate synthesis of prosthetic groups, proteins, and various lipids. Two of the major prosthetic groups, chlorophyll and heme, share a common biosynthetic pathway that diverges at the point of metal insertion into protoporphyrin IX (Proto). Insertion of iron leads to the formation of hemes, while insertion of magnesium is the first step unique to chlorophyll formation. This project is directed toward identifying the enzyme(s) responsible for magnesium chelation and elucidating the mechanism which regulates the flux of precursors through the branch point enzymes in isolated chloroplasts. Using intact chloroplasts from greening cucumber cotyledons, the ATP requirement for Mg-Proto formation was confirmed. Use of non-hydrolyzable ATP analogs, uncouplers and ionophores has led to the conclusions that ATP hydrolysis is necessary, but that this hydrolysis is not linked to the requirement for membrane intactness by transmembrane ion gradients or electrical potentials. The enzyme(s) are flexible with respect to the porphyrin substrate specificity, accepting porphyrins with -vinyl, -ethyl, or -H substituents at the 2 and 4 positions. The activity increases approximately four-fold during greening. Possible physiological feedback inhibitors such as heme, protochlorophyllide, and chlorophyllide had no specific effect on the activity. The activity has now been assayed in barely, corn and peas, with the system from peas almost ten-fold more active than the cucumber system. Work is continuing in pea chloroplasts with the development of a continuous assay and investigation of the feasibility of characterizing an active, organelle-free preparation. DOE

N91-18993*# Oakwood Coll., Huntsville, AL. Dept. of Biological Sciences.
VISUALIZATION OF YEAST CHROMOSOMAL DNA
Seth Lubega *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 06C

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N91-18572# California Univ., Berkeley. Lawrence Berkeley Lab.
DIGITAL RADIOGRAPHY: PRESENT DETECTORS AND FUTURE DEVELOPMENTS
V. Perez-Mendez Aug. 1990 20 p Presented at the 3rd International Conference on Applications of Physics in Medicine and Biology: Medical Diagnostic Imaging, Trieste, Italy, 4-7 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-005386; LBL-29441; CONF-900993-1) Avail: NTIS HC/MF A03

Present detectors for digital radiography are of two classes: real time detectors and storage (non real time) types. Present real time detectors consist of image intensifier tubes with an internal cesium iodide layer x ray converter. Non real time detectors involve linear sweep arrays or storage detectors such as film. Future detectors discussed here can be of both types utilizing new technologies such as hydrogenated amorphous silicon photodiode arrays coupled to thin film transistor arrays. DOE

N91-18573*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MICROBIOLOGY ON SPACE STATION FREEDOM
Duane L. Pierson, ed., Michael R. McGinnis, ed., S. K. Mishra, ed., and Christine F. Wogan, ed. (Krug International, Houston, TX.) Washington Feb. 1991 40 p Conference held in Houston, TX, 6-8 Nov. 1989
(NASA-CP-3108; S-619; NAS 1.55:3108) Avail: NTIS HC/MF A03 CSCL 06C

This panel discussion convened in Houston, Texas, at the Lunar and Planetary Institute, on November 6 to 8, 1989, to review NASA's plans for microbiology on Space Station Freedom. A panel of distinguished scientists reviewed, validated, and recommended revisions to NASA's proposed acceptability standards for air, water, and internal surfaces on board Freedom. Also reviewed were the proposed microbiology capabilities and monitoring plan, disinfection procedures, waste management, and clinical issues. In the opinion of this advisory panel, ensuring the health of the Freedom's crews requires a strong goal-oriented research effort to determine the potential effects of microorganisms on the crewmembers and on the physical environment of the station. Because there are very few data addressing the fundamental question of how microgravity influences microbial function, the panel recommended establishing a ground-based microbial model of Freedom, with subsequent evaluation using in-flight shuttle data. Sampling techniques and standards will be affected by both technological advances in microgravity-compatible instrumentation, and by changes in the microbial population over the life of the station. Author

N91-18574# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
2 Oct. 1990 54 p Transl. into ENGLISH from various Russian

articles
(JPRS-ULS-90-016) Avail: NTIS HC/MF A04

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: aerospace medicine, epidemiology, immunology, microbiology, nonionizing radiation effects, physiology, radiobiology, and virology. For individual titles, see N91-18575 through N91-18578.

N91-18575# Joint Publications Research Service, Arlington, VA.
ORTHOSTATIC STABILITY OF ATHLETES OF DIFFERENT SPECIALIZATIONS AND ITS CHANGE AS PRODUCED BY LOWER GRAVITY Abstract Only
S. V. Dronenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 2 Oct. 1990 p 1 Transl. into ENGLISH from Voyenno-Meditsinskiy Zhurnal, no. 5, May 1989 p 62 (For primary document see N91-18574 10-52)
Avail: NTIS HC/MF A04

The orthostatic stability of athletes of different specializations was examined, and the changes in that stability after a stint under conditions of lower gravity are discussed. The conditions of reduced gravity were simulated by submersion into a dry immersion for three days. During the orthostatic test and during the recovery period, the following indicators of central and peripheral hemodynamics were determined: stroke volume, pulse blood flow of the fermur and crus (by the rheographic method), heart contraction rate (from ECG), and systolic and diastolic blood pressure. Y.S.

N91-18576# Joint Publications Research Service, Arlington, VA.
POSSIBILITY OF USING EVOKED BRAIN POTENTIALS TO DIAGNOSE FLIGHT CREW FATIGUE
V. A. Ponomarenko, S. V. Yegorov, and O. V. Zhernavkov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 2 Oct. 1990 p 1-3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 21-23 (For primary document see N91-18574 10-52)
Avail: NTIS HC/MF A04

The possibilities for using evoked potentials to diagnose fatigue among flight crews when they are performing their jobs are studied. The basic theoretical premise was the accepted fact that as fatigue develops, the physiological price of activity increases, reserve possibilities for processing additional information decline, and performance of a flying assignment worsens in the dynamics of pilot performance. A 10-hour flight on a route with alternating cycles of manual and automatic control was modeled on a flight simulator. An electroencephalogram was recorded during the landing approaches. Auditory stimuli irrelevant to the operator were used to obtain auditory evoked potentials (AEPs). Traditional indicators were used in the analysis of average AEPs - the latent periods of isolated components and their amplitudes. Before and after the experiment the operator used a special scale to evaluate the level of their feeling of fatigue. The quality of activity associated with the landing approach was evaluated. Y.S.

N91-18577# Joint Publications Research Service, Arlington, VA.
PSYCHOLOGICAL PREPARATION OF OPERATORS FOR ACTIVITY DURING SUSTAINED G-LOADS c53
A. A. Oboznov, V. A. Ponomarenko, and D. Yu. Arkhangelskiy *In its* JPRS Report: Science and Technology. USSR: Life Sciences 2 Oct. 1990 p 3-5 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 26-29 (For primary document see N91-18574 10-52)
Avail: NTIS HC/MF A04

The timely performance by an operator of protective measures (primarily the tensing at will of leg and abdominal muscles) prevents the development of visual disturbances accompanying G-loading and thus increases the reliability of his activity. The development of a special mental quality in the operator - the ability to divide one's attention between carrying out an operator task and performing protective measures - is the most important element in the psychological preparation of the individual for successful performance of operator tasks in conditions involving sustained G-loads. The possibility of developing a two-tiered system of mental regulation in ordinary conditions is studied. Y.S.

N91-18578# Joint Publications Research Service, Arlington, VA.
THE MECHANISM OF THE DRUG RESISTANCE OF ESCHERICHIA IN COSMONAUTS
V. K. Ilin *In its* JPRS Report: Science and Technology. USSR: Life Sciences 2 Oct. 1990 p 7-9 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 90-91 (For primary document see N91-18574 10-52)
Avail: NTIS HC/MF A04

The risk of falling ill to infectious diseases grows significantly among people in biological isolation. This shows up in the activation of the conditionally pathogenic component of human auto-microflora, the weakening of the colonization resistance barrier, and the weakening of the immune system. Intensive microbial exchange occurs between people occupying hermetically sealed spaces. The molecular epidemiological features of changes in drug resistance to Escherichia isolated from the intestines of cosmonauts during space flight and from subjects participating in a 30-day simulation study were examined. Y.S.

N91-18579# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
26 Sep. 1990 71 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-90-015) Avail: NTIS HC/MF A04

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: biochemistry, biotechnology, epidemiology, immunology, medicine, nonionizing radiation effects, pharmacology and toxicology, physiology, public health, and virology. For individual titles, see N91-18580 through N91-18582.

N91-18580# Joint Publications Research Service, Arlington, VA.
PHARMACOLOGICAL REGULATION OF PHYSIOLOGICAL FUNCTIONS IN SPACE MEDICINE
V. S. Shaskhov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 26 Sep. 1990 p 1-5 Transl. into ENGLISH from Farmakologiya i Toksikologiya, Moscow (USSR), v. 53, no. 1, Jan.-Feb. 1990 p 5-10 (For primary document see N91-18579 10-52)
Avail: NTIS HC/MF A04

The body's physiological systems that are most sensitive to the effects of weightlessness and subject to pharmacological adjustment at various stages of space flight are examined. Special attention is given to the design and practical application of cardiovascular preparations, and agents for the prevention of motion sickness, as well as substances that affect metabolic processes and mineral saturation of bone tissue. Emphasis is given to the possible use of medical agents in space flights and in practical public health. Author

N91-18581# Joint Publications Research Service, Arlington, VA.
EFFECT OF GRADED PHYSICAL STRESS ON CEREBRAL HEMODYNAMICS IN PILOTS Abstract Only
L. I. Starikov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 26 Sep. 1990 p 6 Transl. into ENGLISH from Voyenno-Meditsinskiy Zhurnal, Moscow (USSR), no. 6, Jun. 1989 p 45-49 (For primary document see N91-18579 10-52)
Avail: NTIS HC/MF A04

An analysis was conducted in the effects of graded physical stress on cerebral hemodynamics in order to refine fitness parameters for pilots. It is shown that, in general, individuals with cardiovascular problems generally presented with hypo- or hyperperfusion of the brain and much greater recovery periods. These are factors that have to be considered in assessing job fitness and in planning flight assignments to avoid undue physical stress. A program of exercise therapy recommended for pilots with hypo- and hyperdynamic extrasystoles is discussed. Y.S.

N91-18582# Joint Publications Research Service, Arlington, VA.
PSYCHOLOGICAL ASSESSMENT OF HORIZON INDICATORS IN PLANES Abstract Only **c54**
V. A. Ponomarenko, V. V. Lapa, and N. A. Lemeshchenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 26 Sep. 1990 p 17 Transl. into ENGLISH from Psikhologicheskiy Zhurnal, Moscow (USSR), v. 11, no. 2, Mar.-Apr. 1990 p 37-46 (For primary document see N91-18579 10-52)
Avail: NTIS HC/MF A04

Psychological studies were conducted on optimum horizon indicators in view of recent findings demonstrating that more than 20 percent of airplane accidents are attributed to spatial disorientation, and that this number is increasing. Trials conducted with flight simulators demonstrated that a display depicting an aircraft in flight against a stationary horizon, i.e., depiction of spatial relationship in a geocentric system of coordinates, facilitates spatial perception in comparison with a moving-horizon display. The key disadvantage of the latter method lies in the requirement for additional information processing necessary for reorientation of the information into geocentric coordinates. Author

N91-18583# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
14 Sep. 1990 54 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-90-014) Avail: NTIS HC/MF A04

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: aerospace medicine, biotechnology, epidemiology, medicine, microbiology, molecular biology, nonionizing radiation effects, pharmacology and toxicology, physiology, public health, radiobiology, and virology. For individual titles, see N91-18584 through N91-18593.

N91-18584# Joint Publications Research Service, Arlington, VA.
CEREBRAL-VASCULAR EFFECTS OF MOTION SICKNESS Abstract Only
Yu. Ye. Moskalenko, A. I. Beketov, V. F. Maksimuk, and N. A. Skoromnyy *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 1 Transl. into ENGLISH from Fiziologicheskiy Zhurnal SSSR imeni I. M. Sechenova, Leningrad (USSR), v. 75, no. 11, Nov. 1989 p 1560-1567 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Cerebral-vascular effects of motion sickness may be expressed not only and not so much in changes of the level of blood supply to the brain as in direct responses to such an effect, predominantly in changes of capacities of the cerebral blood circulation systems to adapt to external effects accompanying motion sickness as the result of reconstruction of neurodynamic processes under its effect. At the same time, changes of activity of the neurogenic component in the mechanism of regulation of cerebral blood circulation may affect not only qualitative indicators of this process but also the state of the water balance of the brain tissue if, against the background of motion sickness, a change of conditions of blood flow from the brain occurs. Author

N91-18585# Joint Publications Research Service, Arlington, VA.
CENTRAL AND SYSTEMIC HEMODYNAMICS IN SIMULATED WEIGHTLESSNESS Abstract Only
R. T. Kazakova and V. P. Katuntsev *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 1-2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 1, Jan. - Feb. 1990 p 15-17 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Central and systemic hemodynamics were assessed in healthy males subjected to simulated weightlessness, which was simulated by water immersion during daytime and -10 C antiorthostasis at night. The resultant monitoring studies demonstrated pronounced time-related hemodynamic shifts. The diminished venous return seen in every subject was interpreted to represent adaptive changes to blood volume redistribution. The mechanism involved the effects of excessive intrathoracic blood volumes on cardiac and vascular volume receptors, activation of which serves to enhance diuresis. As a result, the diastolic end volume falls by approximately 25 percent, a phenomenon that also appears as one of the first manifestations of cardiovascular decompensation in cosmonauts. Author

N91-18586# Joint Publications Research Service, Arlington, VA.
RELATIONSHIP BETWEEN ORTHOSTATIC STABILITY AND POST-SPACE FLIGHT VESTIBULAR FUNCTION IN MAN Abstract Only
V. M. Mikhaylov, L. N. Kornilova, A. F. Zhernakov, A. D. Voskresenskiy, Yu. D. Pometov, and V. N. Alekseyev *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 1, Jan.-Feb. 1990 p 49-50 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Analysis of the relationship between orthostatic stability and vestibular function was performed on cosmonauts after space flight abroad the Salyut-6 space station. Orthostatic and vestibular function tests conducted upon landing and later showed functional deterioration in both tests. In addition, a positive correlation coefficient was obtained for centered results of both tests. Author

N91-18587# Joint Publications Research Service, Arlington, VA.
RELATIONSHIP BETWEEN VERTICAL OPTOKINETIC NYSTAGMUS AND SUSCEPTIBILITY TO MOTION SICKNESS Abstract Only
O. A. Vorobyev, V. V. Zaritskaya, and Yu. V. Krylov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 1, Jan.-Feb. 1990 p 50-52 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

A study was conducted on the relationship between vertical optokinetic nystagmus and motion sickness on healthy males under conditions of simulated weightlessness. The data demonstrated that factors affecting the vestibular apparatus (primarily optolithic receptors) and redistribution of body fluids in the cranial direction modify vertical optokinetic nystagmus to a much greater degree in subjects who are susceptible to motion sickness. These findings confirmed the importance of hemodynamics in the pathogenesis of motion sickness, as well as the fact that studies on vertical optokinetic nystagmus, particularly of downward predominance, may be of prognostic value regarding susceptibility to motion sickness during space flight. Author

N91-18588# Joint Publications Research Service, Arlington, VA.
COLOR SELECTION IN LUSCHER TEST AS EMOTIONAL STATUS INDICATOR IN FLIGHT PERSONNEL Abstract Only **c53**
O. N. Kuznetsov, V. A. Yegorov, and B. S. Frantsen *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 2-3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, Mar.-Apr. 1990 p 15-18 Previously announced as X91-71314 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Color selection in the Luscher test was used in the assessment of emotional status of flight instructors in various field-related situations. In comparison with the population at large, flight personnel showed preference for cooler colors, such as blue, green, or violet. This preference is taken to reflect emotional stress encountered by the pilots in day-to-day situations. In particular, preference for violet and green, a mixture of blue and red or blue and yellow, is understood to reflect adaptibility and flexibility in the face of stress. Author

N91-18589# Joint Publications Research Service, Arlington, VA.
CIRCADIAN PATTERNS IN PLASMA LIPIDS, CARBOHYDRATES, AND SOME HORMONES OF HEALTHY PILOTS Abstract Only
Ye. Ye. Nikolayevskiy *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, Mar.-Apr. 1990 p 21-23 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

A comparative analysis was conducted on the circadian patterns of plasma lipids, hormones, and blood sugar in healthy pilots and an age- and health-equivalent group of non-flight specialists. The results demonstrated that the mean daily lipid and hormone levels in the pilots exceeded the corresponding control levels, usually by a factor of one-fold or better. In the case of blood sugar the relationship was reversed, with the level in the control subjects exceeding the value in pilots. Differences between the two groups were also noted in acrophase values and amplitude parameters. The most pronounced differences in acrophase were noted for blood sugar, beta-lipoproteins, and cholesterol. In general, the shifts were interpreted to reflect pilot adaptability in the face of stress, with the conclusion that these biochemical values may be used in assessment of occupational fitness. Author

N91-18590# Joint Publications Research Service, Arlington, VA.
EXPERIMENTAL ASSESSMENT OF EFFECT OF HEAD POSITION ON CENTER OF GRAVITY OF HUMAN BODY IN EJECTIONS SEATS Abstract Only
G. G. Demirchoglyan, Yu. G. Konakhevich, V. Kh. Petlyuk, R. V. Peshkov, P. N. Khlomenok, L. N. Sholpo, and V. I. Brazhnik *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, Mar.-Apr. 1990 p 24-25 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Kinematic experiments were performed on 55 pilots to assess the effects of head inclination on the body's center of gravity in ejection seats. The purpose was to obtain quantitative data relating trajectory of the ejection seats in relation to anthropometric characteristics, employing a dynamographic stand designed to measure such effects. A two-factor regression equation relating head inclination to change in the center of gravity was derived and used for graph construction. Author

N91-18591# Joint Publications Research Service, Arlington, VA.
ULTRASONIC ASSESSMENT OF HUMAN TIBIA DURING 370-DAY ANTIORTHOSTATIC HYPOKINESIA Abstract Only
A. M. Tatarinov, S. L. Dubonos, Kh. A. Yanson, V. S. Oganov, V. V. Dzenis, and A. S. Rakhmanov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2 Mar.-Apr. 1990 p 29-31 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Studies were conducted on ultrasonic assessment of the effects of simulated weightlessness and exercise therapy on human long bones. The subject were maintained in an antiorthostatic position. Exercise therapy was constant throughout the experiment for some subjects, and for other ones it was started at the beginning of the fifth month. Acoustic profiles for 120 kHz waves revealed considerable individual variations in average velocity, average velocity in the diaphyses, and decrement values in velocity along the distal half of tibia. One year after the experiment all values returned to baseline levels, and the resultant data confirmed the beneficial effects of exercise on human long bones in simulated weightlessness. Author

N91-18592# Joint Publications Research Service, Arlington, VA.
STRESS AND HUMAN CIRCULATION Abstract Only
B. M. Fedorov, T. V. Sebekina, T. M. Sinitsyna, Ye. N. Streltsova, V. M. Vakulenko, and T. G. Nikolayeva *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 4-5 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, May-Jun. 1990 p 35-40 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

A variety of research and diagnostic techniques, including EKG, Doppler echocardiography, Xe-133 labels, etc., were employed in an assessment of human cerebral and systemic circulation during stress. The results demonstrated that intense mental activity potentiated cerebral blood flow, particularly in the supramarginal convolution of the brain, as well as in the angular convolution and in the parietotemporal and occipital region of the left cerebral hemisphere. In most cases an increased flow was also detected in the upper frontal convolution, Broca's convolution, and the superior temporal convolution. Prolonged bed rest was also observed to be a stressful situation predisposing to hypertension. The data were consistent with the view that maximum mental concentration was accompanied by a decrease in heart rate, but that in the majority of cases changes in regional and systemic hemodynamics are predicated on the emotional component of any activity. Cerebral hemodynamics in situations of intense mental activity appear to be closely connected to processes directed at maintaining optimum mental function and seem to be adaptive in nature. In general, mental activity within the framework of time constraints evoked hemodynamic changes that were as pronounced as those induced by submaximal physical demands. Author

N91-18593# Joint Publications Research Service, Arlington, VA.
NEUROTIC AND PSYCHOSOMATIC RISK FACTORS IN FLIGHT PERSONNEL Abstract Only **c53**
V. I. Yevdokimov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 5 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, May-Jun. 1990 p 50-53 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

Flight proficiency testing was combined with personality assessment test in order to ascertain health risk factor in the case of pilots 121 and trainees with neurotic and psychosomatic disorders. In that group, 16 pilots and 8 trainees were diagnosed with asthenic problems, while 34 pilots, 21 pilot trainees, and 42 allied flight personnel were determined to suffer from a variety of psychosomatic disorders. The fundamental findings led to the conclusion that individuals at risk exhibited inadequate mental adaptive potential, in contrast to 165 control subjects without such problems. Author

N91-18594# Pacific Northwest Lab., Richland, WA. Life Sciences Center.
REVISION OF THE ICRP DOSIMETRIC MODEL FOR THE HUMAN RESPIRATORY TRACT
W. J. Bair Dec. 1990 10 p Presented at the 21st Annual NIRS Symposium on Inhalation of Airborne Particles and Induction Mechanisms, Japan, 7-9 Dec. 1989: and at the 3rd International Workshop on Respiratory Tract Dosimetry, Albuquerque, NM, 1-3 Jul. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005086; PNL-SA-17594; CONF-891290-2; CONF-900733-1)
Avail: NTIS HC/MF A02

Although the dosimetric model of the respiratory tract used in ICRP (International Comission on Radiological Protection) Publication 30 had not been shown to be seriously deficient for the purpose of calculating Annual Limits on Intake (ALIs) for workers, the availability of new information led the ICRP in 1984 to create a special Task Group to review the dosimetric model of the respiratory tract and, if justified, propose revisions or a new model. The Task Group directed its efforts toward improving the model used in Publication 30 rather than developing a completely new model. The objective was a model that would facilitate calculation of biologically meaningful doses; be consistent with

morphological, physiological, and radiobiological characteristics of the respiratory tract; incorporate current knowledge; meet all radiation protection needs; be user friendly by not being unnecessarily sophisticated; be adaptable to development of computer software for calculation of relevant radiation doses from knowledge of a few readily measured exposure parameters; be equally useful for assessment purposes as for calculating ALIs; be applicable to all members of the world population; and consider the influence of smoking, air pollutants, and diseases of the inhalation, deposition, and clearance of radioactive particles from the respiratory tract. The model provides for calculation of a committed dose equivalent for each region, adjusted for the relative cancer sensitivity of that region, and for the summing of these to yield a committed dose equivalent for the entire respiratory tract. DOE

N91-18595# New York Univ. Medical Center.
ONCOGENIC ACTION OF IONIZING RADIATION
1990 38 p
(Contract DE-FG02-87ER-60539)
(DE91-005979; DOE/ER-60539/T4) Avail: NTIS HC/MF A03

An extensive experiment involving approximately 400 rats exposed to the neon ion beam at the Bevalac in Berkeley, CA and to electrons is nearing completion. The carcinogenicity of energetic electrons was determined for comparison with the neon ion results. As in past reports we will describe progress in three areas corresponding to the specific aims of the proposal: (1) carcinogenesis and DNA strand breaks in rat skin following exposure by the neon ions or electrons; (2) DNA strand breaks in the epidermis as a function of radiation penetration; (3) oncogene activation in radiation-induced rat skin cancers. DOE

N91-18596# Massachusetts General Hospital, Boston.
NEW IMAGING SYSTEMS IN NUCLEAR MEDICINE
1990 10 p
(Contract DE-FG02-87ER-60519)
(DE91-004782; DOE/ER-60519/T2) Avail: NTIS HC/MF A02

Further progress has been made on improving the uniformity and stability of PCR-I, the single ring analog coded tomograph. This camera has been employed in a wide range of animal studies described below. Data from PCR-I have been used in various image processing procedures. These include motion pictures of dog heart, comparison of PET and MRI image in dog heart and rat brain and quantitation of tumor metabolism in the nude mouse using blood data from heart images. A SUN workstation with TAAC board has been used to produce gated three-dimensional images of the dog heart. The ANALYZE program from the Mayo Clinic has also been mounted on a SUN workstation for comparison of images and image processing. DOE

N91-18597# Lawrence Livermore National Lab., CA. Center for Accelerator Mass Spectrometry.
NEW BIOMEDICAL APPLICATIONS OF RADIOCARBON
J. C. Davis Dec. 1990 14 p Presented at the 40th Anniversary Conference on Radiocarbon, Lake Arrowhead, CA, Jun. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006249; UCRL-JC-105825; CONF-9006308-1) Avail: NTIS HC/MF A03

The potential of accelerator mass spectrometry (AMS) and radiocarbon in biomedical applications is being investigated by Lawrence Livermore National Laboratory (LLNL). A measurement of the dose-response curve for DNA damage caused by a carcinogen in mouse liver cells was an initial experiment. This demonstrated the sensitivity and utility of AMS for detecting radiocarbon tags and led to numerous follow-on experiments. The initial experiment and follow-on experiments are discussed in this report. DOE

N91-18598# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
CONSIDERATIONS OF BETA AND ELECTRON TRANSPORT IN INTERNAL DOSE CALCULATIONS Progress Report
Wesley E. Bolch and John W. Poston, Sr. Dec. 1990 46 p
(Contract DE-FG05-88ER-60707)
(DE91-006251; DOE/ER-60707/T1) Avail: NTIS HC/MF A03

Ionizing radiation has broad uses in modern science and medicine. These uses often require the calculation of energy deposition in the irradiated media and, usually, the medium of interest is the human body. Energy deposition from radioactive sources within the human body and the effects of such deposition are considered in the field of internal dosimetry. In July of 1988, a three-year research project was initiated by the Nuclear Engineering Department at Texas A and M University under the sponsorship of the U.S. Department of Energy. The main thrust of the research was to consider, for the first time, the detailed spatial transport of electron and beta particles in the estimation of average organ doses under the Medical Internal Radiation Dose (MIRD) schema. At the present time (December of 1990), research activities are continuing within five areas. Several are new initiatives begun within the second or third year of the current contract period. They include: (1) development of small-scale dosimetry; (2) development of a differential volume phantom; (3) development of a dosimetric bone model; (4) assessment of the new ICRP lung model; and (5) studies into the mechanisms of DNA damage. A progress report is given for each of these tasks within the Comprehensive Report. In each use, preliminary results are very encouraging and plans for further research are detailed within this document. DOE

N91-18599# National Aerospace Medical Centre, Soesterberg (Netherlands).
THE INCIDENCE OF SLEEP DISTURBANCES IN DUTCH COCKPIT CREW OPERATING ON TRANSMERIDIAN ROUTES
M. Simons and P. J. L. Valk 1989 12 p Presented at the 37th Curation and Space Medicine International Congress, Cairo, Egypt, 15-20 Oct. 1989
(ETN-91-98697) Avail: NTIS HC/MF A03

An inquiry into the occurrence of sleep disturbances among cockpit crew of two Dutch commercial airlines is described. Questionnaires were sent to 1191 cockpit crewmembers. Each anomymized questionnaire comprised 24 items concerning sleep and the use of sleeping aids at home and en route over the last 6 months. The Groningen sleep quality scale was used to evaluate the quality of sleep. The response percentage was 60. A positive correlation between operating on transmeridian flights and complaints about the quality of sleep was demonstrated. The sleep quality en route was significantly worse than at home. Forty seven percent of the transmeridian flying crewmembers with sleep disturbances judged their disturbed sleep to affect their performance in the cockpit. Among the sleeping aids used during lay overs were alcohol (42 percent) and hypnotics (10 percent). It is concluded that transmeridian operations cause significant complaints about the quality of sleep in a large group of Dutch cockpitcrew. A disturbed sleep and the use of sleeping aids, such as alcohol and hypnotics might affect flight safety. ESA

N91-18600# Los Alamos National Lab., NM.
A COMPUTATIONAL MODEL OF THE CEREBELLUM
B. J. Travis 1990 7 p Presented at the Analysis and Modeling of Neural Systems Workshop, Berkeley, 25-27 Jul. 1990
(Contract W-7405-eng-36)
(DE91-004824; LA-UR-90-3733; CONF-9007190-1) Avail: NTIS HC/MF A02

The need for realistic computational models of neural microarchitecture is growing increasingly apparent. While traditional neural networks have made inroads on understanding cognitive functions, more realism (in the form of structural and connectivity constraints) is required to explain processes such as vision or motor control. A highly detailed computational model of mammalian cerebellum was developed. It is being compared to physiological recordings for validation purposes. The model is also being used to study the relative contributions of each component to cerebellar processing. DOE

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N91-18601 Institute for Perception RVO-TNO, Soesterberg (Netherlands).
THE SELECTIVE LISTENING TASK AS A TEST FOR PILOTS AND AIR TRAFFIC CONTROLLERS Final Report
L. C. Boer, M. Harsveld, and P. H. Hermans (Marine Keuring en Selectie Centrum, Amsterdam, Netherlands) 2 May 1990 26 p In DUTCH; ENGLISH summary
(Contract A83/KLu/078)
(IZF-1990-A-18; TD-90-1608; ETN-91-98313) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The use of the Selective Listening Task (Gopher and Kahneman, 1971) as a test for pilots and air traffic controllers was evaluated. Task performance of samples from these populations (88 and 87, respectively) correlated significantly with later success in training. Apparently the task is a suitable selection device. Registration of training motivation revealed that this conclusion was independent of motivation differences. It is recommended to use the first half of the task only and to simplify the scoring procedure. The norms for the conversion of a number of errors to decile scores, based on a sample of 390 pilot applicants, are included. ESA

N91-18577# Joint Publications Research Service, Arlington, VA.
PSYCHOLOGICAL PREPARATION OF OPERATORS FOR ACTIVITY DURING SUSTAINED G-LOADS
A. A. Oboznov, V. A. Ponomarenko, and D. Yu. Arkhangelskiy *In its* JPRS Report: Science and Technology. USSR: Life Sciences 2 Oct. 1990 p 3-5 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 26-29 (For primary document see N91-18574 10-52)
Avail: NTIS HC/MF A04

N91-18588# Joint Publications Research Service, Arlington, VA.
COLOR SELECTION IN LUSCHER TEST AS EMOTIONAL STATUS INDICATOR IN FLIGHT PERSONNEL Abstract Only
O. N. Kuznetsov, V. A. Yegorov, and B. S. Frantsen *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 2-3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, Mar.-Apr. 1990 p 15-18 Previously announced as X91-71314 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

N91-18593# Joint Publications Research Service, Arlington, VA.
NEUROTIC AND PSYCHOSOMATIC RISK FACTORS IN FLIGHT PERSONNEL Abstract Only
V. I. Yevdokimov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 14 Sep. 1990 p 5 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 24, no. 2, May-Jun. 1990 p 50-53 (For primary document see N91-18583 10-52)
Avail: NTIS HC/MF A04

N91-18622*# Houston Univ., Clear Lake, TX. Dept. of Reading and Language Arts.
AN OVERVIEW OF THE EDUCATION AND TRAINING COMPONENT OF RICIS Abstract Only
Glenn B. Freedman *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N91-18602# National Academy of Sciences - National Research Council, Washington, DC. Committee on Human Factors.
BASIC RESEARCH IN HUMAN FACTORS Interim Report, 1984 - 1988
Harold VanCott and Elizabeth Neilsen Jul. 1990 43 p
(Contract MDA903-38-C-0031)
(AD-A226318; ARI-RN-90-78) Avail: NTIS HC/MF A03 CSCL 23/2

This report outlines the purpose, membership, and recent activities of the Committee of Human Factors. It summarizes current studies in the areas of human performance models, multicolored displays, distributed decision making, expert systems, and aging. The report also discusses reports from 1984 through 1988 that represent the areas listed above. GRA

N91-18603*# National Aeronautics and Space Administration, Washington, DC.
SPACESUIT GUIDEBOOK
1991 24 p
(NASA-PED-117; NAS 1.84:117) Avail: NTIS HC/MF A03 CSCL 06K

This guidebook is designed to supplement the Spacesuit wall chart (WAL-114) published by the Education Affairs Division, January 1990. The wall chart depicts Astronaut Bruce McCandless on his historic first untethered spacewalk using the manned maneuvering unit. He flew on Shuttle mission 41-B, and ventured 100 meters for the Shuttle's cargo bay and returned safely. This guidebook explains in depth the elements depicted on the wall chart in see-through and cut-away perspectives. Together the wall chart and guidebook show as well as explain the inside workings of the spacesuit and its various components. Forty separate elements are identified with an accompanying numerical legend. Those elements are further explained in this guidebook along with their functions and how they work in relation to other elements. Additional chapters discuss essential components of the spacesuit such as the primary life support system and the manned maneuvering unit, and the method for donning the spacesuit.
Author

N91-18604# Lawrence Livermore National Lab., CA. Systems and Human Performance.
HUMAN ENGINEERING DESIGN CONSIDERATIONS FOR THE USE OF SIGNAL COLOR ENHANCEMENT IN ASW DISPLAYS
William W. Banks Nov. 1990 89 p
(Contract W-7405-eng-48)
(DE91-004949; UCRL-ID-105261) Avail: NTIS HC/MF A05

The Lawrence Livermore National Laboratory (LLNL) was requested to examine and define man-machine limits as part of the Office of Naval Technology's High Gain Initiative program (HGI). As an initial investigative area, LLNL's Systems and Human Performance effort focused upon color display interfaces and the use of color enhancement techniques to define human and system interface limits in signal detection and discrimination tasks. The knowledgeable and prudent use of color in different types of display is believed to facilitate human visual detection, discrimination and recognition in complex visual tasks. The consideration and understanding of the complex set of interacting variables associated with the prudent use of color is essential to optimize human performance, especially in the ASW community. The designers of advanced display technology and signal processing algorithms may be eventually called upon to present pre-processed information to ASW operators and researchers using the latest color enhancement techniques. These techniques, however, may be limited if one does not understand the complexity and limits of human information processing which reflects the assessed state of knowledge relevant

to the use of color in displays. The initial sections of this report discuss various aspects of color presentation and the problems typically encountered, while the last section deals with a specific research proposal required to further our understanding and proper use of color enhancement methods. DOE

N91-18605# National Aerospace Medical Centre, Soesterberg (Netherlands).
ENVIRONMENTAL FACTORS INFLUENCING FLIGHT CREW PERFORMANCE
M. Simons 1990 14 p Presented at ICAO Human Factors Seminar, Leningrad, USSR, 3-7 Apr. 1990
(ETN-91-98698) Avail: NTIS HC/MF A03

Developments in commercial aviation have changed the pilot's task to that of a flight systems manager. In this task optimum vigilance is required. It is anticipated that the performance of the modern pilot might be impaired by the cumulative effects of frequent disturbance of sleep and prolonged exposure to mild hypoxia, low relative humidity, ozone, and noise. The effects of loss of sleep, lower cabin pressure, low relative humidity, ozone, and noise on a pilot's performance is discussed. Research on the effects of the combination of environmental factors on performance is recommended. Such research should include controlled studies under cockpit environmental conditions, employing over time assessment of psychological performance, and using tasks that are representative for the task of a modern pilot. Conditions to be included in such a study are given. ESA

N91-18606# National Aerospace Medical Centre, Soesterberg (Netherlands). Dept. of Research and Development.
COCKPIT-ENVIRONMENTAL FACTORS DURING LONG-RANGE FLIGHTS
M. Simons Apr. 1989 52 p Sponsored by Civil Aviation Authority, Netherlands
(REPT-89-02-RLD; ETN-91-98699) Avail: NTIS HC/MF A04

As a result of the increase of the average sector length flown by most international airlines, flight crew is exposed to the aircraft cabin environment for a longer period of time. Scientific literature is reviewed with respect to the effects of prolonged (greater than 8 hours) exposure to cockpit environmental conditions on well being and performance of flight crew. The effects of cabin pressure, relative humidity, ozone, cosmic radiation, noise and vibration are discussed in detail. Recommendations for future studies are formulated. ESA

N91-18077# Military Airlift Command, Scott AFB, IL.
AIRCREW FATIGUE COUNTERMEASURES
Stephens F. McCauley *In* AGARD, Progress in Military Airlift Dec. 1990 6 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18078# Military Airlift Command, Scott AFB, IL. Test and Evaluation Div.
AIRCREW EYE/RESPIRATORY PROTECTION: A MILITARY AIRLIFT COMMAND PERSPECTIVE
James Sousa *In* AGARD, Progress in Military Airlift Dec. 1990 9 p (For primary document see N91-18067 10-03)
Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-18127*# Colorado Univ., Boulder.
METHODS FOR THE DEVELOPMENT OF A BIOREGENERATIVE LIFE SUPPORT SYSTEM
Michelle Goldman, Shawn Gomez, and Mike Voorhees *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 41-47 Sponsored by NASA, Ames Research Center (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

N91-18128*# Florida Univ., Gainesville.
IMPLEMENTATION OF SENSOR AND CONTROL DESIGNS FOR BIOREGENERATIVE SYSTEMS
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 49-52 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

N91-18137*# Kansas State Univ., Manhattan.
AUTOMATION OF CLOSED ENVIRONMENTS IN SPACE FOR HUMAN COMFORT AND SAFETY
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 99-103 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

N91-18150*# Puerto Rico Univ., Rio Piedras. School of Architecture.
HABITABILITY: CAMELOT 4
W. Alequin, A. Barragan, M. Carro, F. Garcia, I. Gonzalez, J. A. Mercado, N. Negron, D. Lopez, L. A. Rivera, and M. Rivera et al *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 187-193 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

N91-18158*# Wisconsin Univ., Milwaukee. Dept. of Architecture.
GENESIS LUNAR OUTPOST: AN EVOLUTIONARY LUNAR HABITAT
Gary T. Moore, comp., Dino Baschiera, Joe Fieber, and Janis Moths *In* USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 241-254 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 06K

N91-18582# Joint Publications Research Service, Arlington, VA.
PSYCHOLOGICAL ASSESSMENT OF HORIZON INDICATORS IN PLANES Abstract Only
V. A. Ponomarenko, V. V. Lapa, and N. A. Lemeshchenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 26 Sep. 1990 p 17 Transl. into ENGLISH from Psikhologicheskiy Zhurnal, Moscow (USSR), v. 11, no. 2, Mar.-Apr. 1990 p 37-46 (For primary document see N91-18579 10-52)
Avail: NTIS HC/MF A04

N91-19014*# New Mexico Highlands Univ., Las Vegas. Dept. of Engineering Technology.
BIOREGENERATIVE LIFE SUPPORT
Bill Taylor *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 06K

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N91-18607# Center for Mathematics and Computer Science, Amsterdam (Netherlands).
[ACTIVITIES REPORT OF THE CENTER FOR MATHEMATICS

AND COMPUTER SCIENCE] Annual Report, 1989
1990 73 p
(ETN-91-98774) Avail: NTIS HC/MF A04

CWI, a Dutch center of mathematics and computer science, is a non profit institution aiming at the promotion of mathematics, computer science and their applications. An introduction to this institute, covering the financing, evaluation of research projects, activities with ERCIM (European Research Consortium for Informatics and Mathematics), projects, conferences and courses, and noteworthy events, is given in the journal. Reports on the main line of work and projects of the following departments during 1989 are given: analysis, algebra and geometry; operations research, statistics and system theory; numerical mathematics; software technology; algorithms and architecture; interactive systems; computer systems and telematics. Details of programs, finance, personnel, foreign visitors and publications are included. ESA

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N91-18608# L and S Computer Technology, Inc., Austin, TX.
PERFORMANCE ENGINEERING FOR MISSION CRITICAL EMBEDDED COMPUTER SYSTEMS Final Report
Jun. 1990 68 p
(Contract N00039-86-C-0247)
(AD-A228643; NOSC/TD-1834) Avail: NTIS HC/MF A04
CSCL 12/7

Background information is provided on performance engineering and the POD performance modeling tool, and an overview is given of the project activities. Finally, the project summary section reviews the results, lessons learned, and suggests future direction. Naval mission critical, embedded computer systems (MC-ECS) must respond to external events within their allotted time, otherwise they fail. Failures may have life or death consequences. Lifecycle performance management, or performance engineering (PE), calls for building performance into systems beginning in the requirements definition phase, and continuing the performance management through the design, implementation, testing, and post deployment phases. Experience with PE shows that it can detect and avoid project threatening performance failures in sufficient time to correct them and enable timely delivery of a quality product. Furthermore, performance is orders of magnitude better with this approach than with a fix it later approach in which performance considerations are deferred to the testing phase and, when necessary, tuning attempts to correct performance failures. Better performance means both people and computer resources can be used to enhance the functionality of the system rather than to correct performance deficiencies. GRA

N91-18609# Ames Lab., IA.
THE DESIGN OF A SCALABLE, FIXED-TIME COMPUTER BENCHMARK
John Gustafson, Diane Rover, Stephen Elbert, and Michael Carter Oct. 1990 24 p
(Contract W-7405-eng-82)
(DE91-007118; IS-5049) Avail: NTIS HC/MF A03

By using the principle of fixed time benchmarking, it is possible to compare a very wide range of computers, from a small personal computer to the most powerful parallel supercomputer, on a single scale. Fixed time benchmarks promise far greater longevity than those based on a particular problem size, and are more appropriate for grand challenge capability comparison. The design is presented of a benchmark, SLALOM (trademark), that scales automatically to the computing power available, and corrects several deficiencies in various existing benchmarks: it is highly scalable, it solves a real problem, it includes input and output times, and it can be run on parallel machines of all kinds, using any convenient language. The benchmark provides a reasonable estimate of the size of problem solvable on scientific computers. Results are presented that span six orders of magnitude for contemporary computers of various architectures. The benchmarks also can be used to demonstrate a new source of superlinear speedup in parallel computers. DOE

N91-18610*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
DISTRIBUTED MEMORY COMPILER DESIGN FOR SPARSE PROBLEMS Final Report
Janet Wu, Joel Saltz, Harry Berryman, and Seema Hiranandani (Rice Univ., Houston, TX.) Jan. 1991 41 p Submitted for publication
(Contract NAS1-18605; NSF ASC-88-19374)
(NASA-CR-187515; ICASE-91-13; NAS 1.26:187515) Avail: NTIS HC/MF A03 CSCL 09B

A compiler and runtime support mechanism is described and demonstrated. The methods presented are capable of solving a wide range of sparse and unstructured problems in scientific computing. The compiler takes as input a FORTRAN 77 program enhanced with specifications for distributing data, and the compiler outputs a message passing program that runs on a distributed memory computer. The runtime support for this compiler is a library of primitives designed to efficiently support irregular patterns of distributed array accesses and irregular distributed array partitions. A variety of Intel iPSC/860 performance results obtained through the use of this compiler are presented. Author

N91-18611# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ATM MULTICAST CONNECTIONS USING THE GAUSS SWITCH
Rein J. F. deVries (Dutch Post Office, Dr. Neher Lab., Leidschendam.) 21 Sep. 1990 9 p
(MEMO-INF-90-53; EL-075-IR-9028; ISSN-0923-1714; ETN-91-98669) Avail: NTIS HC/MF A02

In order to support multiparty calls in B-ISDN (Broadband-Integrated Services Digital Network) ATM (Asynchronous Transfer Mode), switches with good multicast capabilities are required. Gauss is an architecture for a high speed ATM Switching Element (ASE) which can easily be adjusted in order to meet this demand. Gauss uses output queueing, a broadcast bus, a limited increase in internal speed and self routing method to get a number of favorable properties. Due to a repeating and regular structure the Gauss ASE is modular resulting in an ASE that can easily grow towards a large ATM Switching Fabric (ASF). Although a broadcast bus is used multicast capability cannot be provided that easily. A number of modifications and additions by which Gauss ASE can offer multicast connections to the user are discussed and evaluated. ESA

N91-18612# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
BUFFER CACHE DESIGN OF THE TUMULT FILESYSTEM
Xie Peng, G. C. H. Terlien, and Pierre G. Jansen Oct. 1990 16 p
(MEMO-INF-90-65; ISSN-0923-1714; ETN-91-98678) Avail: NTIS HC/MF A03

The design and implementation of a disk block caching method is described. Disk block caching is a widely used method in computer design to improve the input output performance. The disk block caching method described is part of the high performance parallel filesystem designed for the TUMULT (Twente University Multicomputer) multicomputer. The filesystem relies on a multiversion scheme allowing multiple readers and one writer acting simutaneously on a file. The major benefit of the multiversion scheme is that opened files are always kept consistent, so caches never have to be invalidated. The filesystem is being implemented on a TUMULT 64 parallel computer. A systematic management

scheme and the organization of the buffer caches is presented. ESA

N91-18613*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SHARED VERSUS DISTRIBUTED MEMORY MULTIPROCESSORS Final Report
Harry F. Jordan Jan. 1991 20 p Presented at the European Centre for Medium Range Weather Forecasts Workshop on Use of Parallel Processors in Meteorology, 26-30 Nov. 1990 Submitted for publication
(Contract NAS1-18605; NSF G87-17773)
(NASA-CR-187501; ICASE-91-7; NAS 1.26:187501) Avail: NTIS HC/MF A03 CSCL 09B

The question of whether multiprocessors should have shared or distributed memory has attracted a great deal of attention. Some researchers argue strongly for building distributed memory machines, while others argue just as strongly for programming shared memory multiprocessors. A great deal of research is underway on both types of parallel systems. Special emphasis is placed on systems with a very large number of processors for computation intensive tasks and considers research and implementation trends. It appears that the two types of systems will likely converge to a common form for large scale multiprocessors. Author

N91-18614# Westinghouse Savannah River Co., Aiken, SC.
CLIENT/SERVER MODELS FOR TRANSPARENT, DISTRIBUTED COMPUTATIONAL RESOURCES
K. E. Hammer and T. L. Gilman 1991 11 p Presented at the International Topical Meeting on Advances in Mathematics, Computations, and Reactor Physics, Pittsburgh, 28 Apr. - 2 May 1991
(Contract DE-AC09-89SR-18035)
(DE91-007240; WSRC-MS-90-347; CONF-910414-8) Avail: NTIS HC/MF A03

Client/server models are proposed to address issues of shared resources in a distributed, heterogeneous UNIX environment. Recent development of automated remote procedure call (RPC) interface generator has simplified the development of client/server models. Previously, implementation of the models was only possible at the UNIX socket level. An overview of RPCs and the interface generator will be presented and will include a discussion of generation and installation of remote services, the RPC paradigm, and the three levels of RPC programming. Two applications, the nuclear plant analyzer (NPA) and a fluids simulation using molecular modelling, will be presented to demonstrate how client/server models using RPCs and external data representations (XDR) have been used production/computation situations. The NPA incorporates a client/server interface for transferring/translation of TRAC or RELAP results from the UNICOS Cray to a UNIX workstation. The fluids simulation program utilizes the client/server model to access the Cray via a single function allowing it to become a shared co-processor to the workstation application. DOE

N91-18989*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
SYSTEM IDENTIFICATION AND CONTROLLER DESIGN USING EXPERIMENTAL FREQUENCY RESPONSE DATA
R. Dennis Irwin *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N91-18615*# Southwest Research Inst., San Antonio, TX.
RESEARCH INTO DISPLAY SHARING TECHNIQUES FOR DISTRIBUTED COMPUTING ENVIRONMENTS Final Report
Steven B. Hugg, Paul F. Fitzgerald, Jr., Nina Y. Rosson, and Stephen R. Johns 22 May 1990 402 p
(Grant NAG9-370; SwRI Proj. 05-2922)
(NASA-CR-186570; NAS 1.26:186570) Avail: NTIS HC/MF A18 CSCL 09B

The X-based Display Sharing solution for distributed computing environments is described. The Display Sharing prototype includes the base functionality for telecast and display copy requirements. Since the prototype implementation is modular and the system design provided flexibility for the Mission Control Center Upgrade (MCCU) operational consideration, the prototype implementation can be the baseline for a production Display Sharing implementation. To facilitate the process the following discussions are presented: Theory of operation; System of architecture; Using the prototype; Software description; Research tools; Prototype evaluation; and Outstanding issues. The prototype is based on the concept of a dedicated central host performing the majority of the Display Sharing processing, allowing minimal impact on each individual workstation. Each workstation participating in Display Sharing hosts programs to facilitate the user's access to Display Sharing as host machine. Author

N91-18616*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
RICIS 1987 SYMPOSIUM. EXECUTIVE SUMMARY
A. Glen Houston, ed. 1987 348 p Symposium held in Clear Lake, TX, 14-15 Oct. 1987
(Contract NCC9-16)
(NASA-CR-187906; NAS 1.26:187906) Avail: NTIS HC/MF A15 CSCL 09B

Papers presented at the RICIS (Research Institute for Computing and Information Systems) of the University of Houston - Clear Lake are compiled. The following subject areas are covered: NASA JSC/UH - Clear Lake cooperative research program; the RICIS concept; RICIS research; and RICIS research areas. For individual titles, see N91-18617 through N91-18623.

N91-18617*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE RICIS CONCEPT
Robert B. MacDonald *In* Houston Univ., RICIS 1987 Symposium. Executive Summary 1987 35 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

A cooperative program was initiated by JSC with the University of Houston - Clear Lake to support research in computing and information systems. The objective of this program is to provide continuing long-term research in support of the numerous mission and mission-related endeavors of NASA/JSC. The Research Institute for Computing and Information Systems (RICIS) concept is presented in form of viewgraphs. History of RICIS, its organization, and research status are discussed. Y.S.

N91-18618*# Houston Univ., Clear Lake, TX. High Technology Lab.
RICIS RESEARCH
Charles W. McKay, Terry Feagin, Peter C. Bishop, Cecil R. Hallum, and Glenn B. Freedman *In its* RICIS 1987 Symposium. Executive Summary 1987 5 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

The principle focus of one of the RICIS (Research Institute for Computing and Information Systems) components is computer

systems and software engineering in-the-large of the lifecycle of large, complex, distributed systems which: (1) evolve incrementally over a long time; (2) contain non-stop components; and (3) must simultaneously satisfy a prioritized balance of mission and safety critical requirements at run time. This focus is extremely important because of the contribution of the scaling direction problem to the current software crisis. The Computer Systems and Software Engineering (CSSE) component addresses the lifestyle issues of three environments: host, integration, and target. Y.S.

N91-18619*# Houston Univ., Clear Lake, TX. Dept. of Computer Science.
AN OVERVIEW OF THE ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS COMPONENT OF RICIS Abstract Only **c63**
Terry Feagin *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

Artificial Intelligence and Expert Systems are the important component of RICIS (Research Institute and Information Systems) research program. For space applications, a number of problem areas that should be able to make good use of the above tools include: resource allocation and management, control and monitoring, environmental control and life support, power distribution, communications scheduling, orbit and attitude maintenance, redundancy management, intelligent man-machine interfaces and fault detection, isolation and recovery. Y.S.

N91-18620*# Houston Univ., Clear Lake, TX. Space Business Information Center.
AN OVERVIEW OF THE INFORMATION MANAGEMENT COMPONENT OF RICIS Abstract Only **c82**
Peter C. Bishop *In its* RICIS 1987 Symposium. Executive Summary 1987 2 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 12A

Information management is the RICIS (Research Institute for Computing and Information Systems) research area which covers four types of tasks initiated during the first year of research: (1) surveys - a description of the existing state of some area in computing and information systems; (2) forecasts - a description of the alternative future states of some area; (3) plans - an approach to accomplishing some objective in the future; and (4) demonstrations - working prototypes and field trials to study the feasibility and the benefits of a particular information system. The activity in these research areas is described. Y.S.

N91-18621*# Houston Univ., Clear Lake, TX. Dept. of Mathematics.
AN OVERVIEW OF THE MATHEMATICAL AND STATISTICAL ANALYSIS COMPONENT OF RICIS Abstract Only **c65**
Cecil R. Hallum *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 05I

Mathematical and statistical analysis components of RICIS (Research Institute for Computing and Information Systems) can be used in the following problem areas: (1) quantification and measurement of software reliability; (2) assessment of changes in software reliability over time (reliability growth); (3) analysis of software-failure data; and (4) decision logic for whether to continue or stop testing software. Other areas of interest to NASA/JSC where mathematical and statistical analysis can be successfully employed include: math modeling of physical systems, simulation, statistical data reduction, evaluation methods, optimization, algorithm development, and mathematical methods in signal processing. Y.S.

N91-18622*# Houston Univ., Clear Lake, TX. Dept. of Reading and Language Arts.
AN OVERVIEW OF THE EDUCATION AND TRAINING COMPONENT OF RICIS Abstract Only **c53**
Glenn B. Freedman *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

Research in education and training according to RICIS (Research Institute for Computing and Information Systems) program focuses on means to disseminate knowledge, skills, and technological advances rapidly, accurately, and effectively. A range of areas for study include: artificial intelligence, hypermedia and full-text retrieval strategies, use of mass storage and retrieval options such as CD-ROM and laser disks, and interactive video and interactive media presentations. Y.S.

N91-18623*# National Aeronautics and Space Administration, Washington, DC.
A NASA INITIATIVE: SOFTWARE ENGINEERING FOR RELIABLE COMPLEX SYSTEMS
Lee B. Holcomb *In* Houston Univ., RICIS 1987 Symposium. Executive Summary 1987 26 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

The objective is the development of methods, technology, and skills that will enable NASA to cost-effectively specify, build, and manage reliable software which can evolve and be maintained over an extended period. The need for such software is rooted in the increasing integration of software and computing components into NASA systems. Current NASA Software Engineering expertise was applied toward some of the largest reliable systems including: shuttle launch; ground support; shuttle simulation; minor control; satellite tracking; and scientific data systems. Unfortunately, no theory exists for reliable complex software systems. NASA is seeking to fill this theoretical gap through a number of approaches. One such approach is to conduct research on theoretical foundations for managing complex software systems. It includes: communication models, new and modified paradigms, and life-cycle models. Another approach is research in the theoretical foundations for reliable software development and validation. It focuses upon formal specifications, programming languages, software engineering systems, software reuse, formal verification, and software safety. Further approaches involve benchmarking a NASA software environment, experimentation within the NASA context, evolution of present NASA methodology, and transfer of technology to the space station software support environment. Y.S.

N91-18624# Wickersheimer Engineers, Inc., Champaign, IL.
TUTORIAL GUIDE: COMPUTER AIDED STRUCTURAL MODELING (CASM), VERSION 1.01 Final Report
David Wickersheimer, Gene McDermott, Ken Taylor, and Carl Roth Sep. 1990 261 p
(Contract DACA39-86-C-0024)
(AD-A228402; WES/IR/ITL-90-4) Avail: NTIS HC/MF A12 CSCL 12/5

This tutorial describes the use of the computer program CASM, which is designed to aid the structural engineer in the preliminary design and evaluation of structural building systems by the use of 3-D interactive graphics. CASM is a preliminary structural design program that incorporates a Structural Planning philosophy. Structural Planning is the study of structural system alternatives within the context of each project's unique set of program criteria. The goal of structural planning, and thus CASM, is to select the most appropriate, efficient, and economical structural system which satisfies established program criteria while integrating the mechanical requirements and complementing the intended aesthetics. The structural planning process must begin during the preliminary design phase, when major decisions regarding form, function, and aesthetics are being firmly established. CASM provides fast, interactive brainstorming, a catalyst for the creative exchange of ideas by the exploration of options that fulfill a desired result. CASM enables the engineer to rapidly answer the question, What if. The structural engineer needs to develop alternatives, approximate proportions, ramifications on the architectural criteria, and implications on cost. Usually, several structural framing schemes are feasible for any given building program. CASM,

through the structural planning process, produces an approximate analysis of each solution, to permit the engineer to compare and test each schemes' appropriateness. GRA

N91-18625# Wickersheimer Engineers, Inc., Champaign, IL.
USER'S GUIDE: COMPUTER AIDED STRUCTURAL MODELING (CASM), VERSION 1.01 Final Report
David Wickersheimer, Gene McDermott, Ken Taylor, and Carl Roth Sep. 1990 207 p
(Contract DACA39-86-C-0024)
(AD-A228456; WES/CR/ITL-90-5) Avail: NTIS HC/MF A10 CSCL 12/5

CASM (Computer Aided Structural Modeling) is a program designed to aid the structural engineer in the preliminary design and evaluation of structural building systems by the use of 3-D interactive graphics. Think of this program as a scratch pad for the structural decision process that would have been done on paper before you went to the computer to do the final numerical analysis of structural members. CASM will let you change your mind quickly and give you results that previously might have taken hours to obtain. By allowing quick changes, CASM allows you to make more informed decisions in the initial structural evaluation process. Its purpose is to help solve those basic early problems that all engineers face when trying to fit a structural system into a building. This is the first release of the program (Version 1.01). Not all options are implemented at this time (a message that you may see when using this program). But do not fear; what you are getting is a usable, functional, practical program that will help you solve many basic problems much faster and easier than your present methods. The areas that are addressed in this program include: (1) Basic Design Criteria; (2) Dead and Live Loads; (3) Snow and Wind Loads; (4) Building Geometry and Structural Layout; and (5) Member Analysis and Preliminary Sizing. GRA

N91-18626# Lawrence Livermore National Lab., CA. Computer Research Group.
ARRAYS IN SISAL
John T. Feo Sep. 1990 17 p Presented at the 1st International Workshop on Arrays, Functional Languages, and Parallel Systems, Montreal, Quebec, 12-14 Jun. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005400; UCRL-JC-106081; CONF-9006303-1) Avail: NTIS HC/MF A03

Although Sisal (Streams and Iterations in a Single Assignment Language) is a general-purpose applicative language, its expected program domain is large-scale scientific applications. Since arrays are an indispensable data structure for such applications, the designers of Sisal included arrays and a robust set of array operations in the language definition. In this paper, we review and evaluate those design decisions in light of the first Sisal compilers and runtime systems for shared-memory multiprocessor systems. In general, array intensive applications written in Sisal 1.2 execute as fast as their Fortran equivalents. However, a number of design decisions have hurt expressiveness and performance. We discuss these flaws and describe how the new language definition (Sisal 2.0) corrects them. DOE

N91-18627# L and S Computer Technology, Inc., Austin, TX.
SOFTWARE PERFORMANCE ENGINEERING FOR REALTIME SYSTEMS Final Report
Jun. 1990 311 p
(Contract N00014-86-C-0247)
(AD-A229121; NOSC/TD-1830) Avail: NTIS HC/MF A14 CSCL 12/5

The agenda included the following topics: INTRODUCTION - What is SPE, What is POD, Role of modeling in the lifecycle vs. fix it later; SOFTWARE PERFORMANCE MODELING INTRO. Data Requirements: performance goals, workload, environment, software structure, resource requirements; LAB EXERCISE I. POD Tool introduction - Problem 1: Static analysis; Problem 2: Revise software; ROLE OF STATIC ANALYSIS IN SOFTWARE LIFECYCLE; SYSTEM MODELING; SPE IN THE LIFECYCLE. GRA

N91-18628# Unisys Corp., Reston, VA. Tactical Systems Div.
SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS (STARS). REUSABILITY LIBRARY (RLF) AdaTAU SOFTWARE USER'S MANUAL Final Report
James J. Solderitsch and Ray McDowell 26 Oct. 1990 116 p
(Contract F19628-88-D-0031)
(AD-A229221; GR-7670-1171(NP); STARS-RC-01210/003/00)
Avail: NTIS HC/MF A06 CSCL 12/5

This document assumes that the user has a basic understanding of the Ada language and wishes to learn how to incorporate knowledge-based capabilities into a larger system. This Software User's Manual provides a description of the content and basic operating procedures of AdaTAU, subsystem level component of the AdaTAU, a subsystem level component of the Reusability Library Framework (RLF). Other major components of the RLF include AdaKNET, and the Librarian application, which are covered in separate user's manuals. AdaTAU provides knowledge representation and inferencing capabilities via rule and fact base abstractions, and an associated control strategy that supports the extension of fact bases following the application of rules drawn from the rule bases. AdaTAU is made up of various packages providing Abstract Data Types (ADTs) that form the basis for the collection of services and objects provided within AdaTAU. This manual describes the individual package level components, as well as the major operations and objects defined within each component. The purpose of AdaTAU is to provide a rule-based knowledge representation capability within the RLF and to serve as a stand-alone subsystem that can be incorporated into larger Ada systems which require a rule-based component. GRA

N91-18629# Lawrence Livermore National Lab., CA. Laser Engineering Div.
DECONVOLUTION/IDENTIFICATION TECHNIQUES FOR 1-D TRANSIENT SIGNALS
Dennis M. Goodman 1 Oct. 1990 40 p
(Contract W-7405-eng-48)
(DE91-004930; UCRL-ID-104862) Avail: NTIS HC/MF A03

This paper discusses a variety of nonparametric deconvolution and identification techniques that we have developed for application to 1-D transient signal problems. These methods are time-domain techniques that use direct methods for matrix inversion. Therefore, they are not appropriate for large data problems. These techniques involve various regularization methods and permit the use of certain kinds of a priori information in estimating the unknown. These techniques have been implemented in a package using standard FORTRAN that should make the package readily transportable to most computers. This paper is also meant to be an instruction manual for the package. DOE

N91-18630# Lawrence Livermore National Lab., CA.
LINEARIZATION ALGORITHMS FOR LINE TRANSFER
Howard A. Scott Nov. 1990 12 p Presented at the 1990 Nuclear Explosives Code Developers' Conference, Monterey, CA, 6-9 Nov. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005262; UCRL-JC-105464; CONF-9011149-6) Avail: NTIS HC/MF A03

Complete linearization is a very powerful technique for solving multi-line transfer problems that can be used efficiently with a variety of transfer formalisms. The linearization algorithm we describe is computationally very similar to ETLA, but allows an effective treatment of strongly-interacting lines. This algorithm has been implemented (in several codes) with two different transfer formalisms in all three one-dimensional geometries. A variation of the algorithm that handles saturable laser transport is described. Finally, a combination of linearization with a local approximate operator formalism, which has been implemented in two dimensions and is being developed in three dimensions, is presented. DOE

N91-18631*# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
PROBLEMS IN CHARACTERIZING BARRIER PERFORMANCE Interim Report

Harry F. Jordan Oct. 1988 15 p
(Contracts NAS1-17070; N00014-86-K-0204; NAG1-640)
(NASA-CR-187930; NAS 1.26:187930; ECE-TR-88-1-4; CSDG-88-3) Avail: NTIS HC/MF A03 CSCL 09B

The barrier is a synchronization construct which is useful in separating a parallel program into parallel sections which are executed in sequence. The completion of a barrier requires cooperation among all executing processes. This requirement not only introduces the wait for the slowest process delay which is inherent in the definition of the synchronization, but also has implications for the efficient implementation and measurement of barrier performance in different systems. Types of barrier implementation and their relationship to different multiprocessor environments are described. Then the problem of measuring the performance of barrier implementations on specific machine architecture is discussed. The fact that the barrier synchronization requires the cooperation of all processes makes the problem of performance measurement similarly global. Making non-intrusive measurements of sufficient accuracy can be tricky on systems offering only rudimentary measurement tools. Author

N91-18632*# Houston Univ., Clear Lake, TX. Software Engineering Professional Education Center.
ADDRESSING HYPERTEXT DESIGN AND CONVERSION ISSUES
Robert J. Glusko 1990 86 p Presented at the Hypermedia and Information Reconstruction Conference, Houston, TX, 3 Dec. 1990
(Contract NCC9-16)
(NASA-CR-187934; NAS 1.26:187934) Avail: NTIS HC/MF A05 CSCL 09B

Hypertext is a network of information units connected by relational links. A hypertext system is a configuration of hardware and software that presents a hypertext to users and allows them to manage and access the information that it contains. Hypertext is also a user interface concept that closely supports the ways that people use printed information. Hypertext concepts encourage modularity and the elimination of redundancy in data bases because information can be stored only once but viewed in any appropriate context. Hypertext is such a hot idea because it is an enabling technology in that workstations and personal computers finally provide enough local processing power for hypertext user interfaces. Author

N91-18633*# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Science.
INPUT/OUTPUT BEHAVIOR OF SUPERCOMPUTING APPLICATIONS
Ethan L. Miller Jan. 1991 32 p
(Grant NAG2-591)
(NASA-CR-187956; NAS 1.26:187956; UCB/CSD-91/616) Avail: NTIS HC/MF A03 CSCL 09B

The collection and analysis of supercomputer I/O traces and their use in a collection of buffering and caching simulations are described. This serves two purposes. First, it gives a model of how individual applications running on supercomputers request file system I/O, allowing system designer to optimize I/O hardware and file system algorithms to that model. Second, the buffering simulations show what resources are needed to maximize the CPU utilization of a supercomputer given a very bursty I/O request rate. By using read-ahead and write-behind in a large solid stated disk, one or two applications were sufficient to fully utilize a Cray Y-MP CPU. Author

N91-18634# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
AN ATTRIBUTED ELL(1)-PARSER GENERATOR
Henk Alblas and Joos Schaap-Krusema May 1990 17 p
(MEMO-INF-90-23; ISSN-0923-1714; ETN-91-98651) Avail: NTIS HC/MF A03

The Twente Compiler Generating System (TCGS) consists of four modules: a scanner generator, a combined parser and attribute evaluator generator, a standard routine module, and an interpreter. It builds compilers in VAX PASCAL. The parser and attribute evaluator generator are described. The parser generator is based on extended context free grammars and supports the use of attributes and attributed evaluation rules. The system checks if the input grammar satisfies the ELL(1) conditions, verifies the reachability and availability of the attributes, and generates an attributed recursive descent parser, which supports both syntactic and semantic error recovery. The system has been used both as a tool to construct compiler front ends, and as a teaching tool. The system is still under development and facilities for the generation of abstract syntax trees are being added. ESA

N91-18635# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DECOMPOSITION OF FUNCTIONALITY: A CORRECTNESS PRESERVING LOTOS TRANSFORMATION
Rom Langerak Jun. 1990 16 p Sponsored in part by EEC
(MEMO-INF-90-27; ISSN-0923-1714; ETN-91-98654) Avail: NTIS HC/MF A03

Algorithms for transforming a single LOTOS (Language of Temporal Ordering Specification) process into two interacting processes are presented. The two processes interact via either synchronous or asynchronous communication. The result of the transformation is proven to be weak bisimulation equivalent with the original process. This transformation has applications in the modularization of a design, the refinement of a service into a protocol, and the derivation of upper and lower testers for conformance testing. Two obvious extensions of the work are the incorporation of full LOTOS, so including datatypes and value passing, and the development of an automatic tool implementing the algorithms. ESA

N91-18636# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
EXTENDING THE SEMANTICS OF SUBTYPING, ACCOMMODATING DATABASE MAINTENANCE OPERATIONS
Chris deVreeze Jun. 1990 25 p
(MEMO-INF-90-29; ISSN-0923-1714; ETN-91-98656) Avail: NTIS HC/MF A03

Until recently, artificial intelligence, databases and programming languages were regarded as three fairly separate areas of research. The integration of these disciplines is recommended. The result from an effort to build a bridge between the relational model of databases and a formal object oriented language is presented. Fortunately, an elegant and fairly straightforward extension of the language suffices to incorporate databases and some maintenance evaporations (e.g., insert, delete, update), without invalidating the accompanying theory. Implementation issues are not considered. The aim is to contribute to a better (formal) understanding of databases in a programming environment. A paper called subtyping can have a simple semantics is included and the structure of that paper is followed, discussing the extended language. Only modifications and extensions are described. Certain semantical intentions may be expressed in the language in more than one way so the motion of semantical equivalence, is introduced. Foundations laid for defining databases and maintenance operations and some rcommendations for further research are made. ESA

N91-18637# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FDTS FOR OPEN DISTRIBUTED SYSTEMS, A RETROSPECTIVE AND A PROSPECTIVE VIEW
Chris A. Vissers Jun. 1990 24 p Sponsored in part by EEC
(MEMO-INF-90-33; ISSN-0923-1714; ETN-91-98658) Avail: NTIS HC/MF A03

Personal views on the development of Formal Description Techniques (FDTs) in the last ten years and some perspectives for the next ten years are presented. The statements made apply in particular for FDTs for open distributed systems. An historical overview of FDT development is given. Guidelines for FDT application, FDT architectural semantics, tutorials for FDTs and graphical LOTOS (Language Of Temporal Ordering Specification),

and testing are described. FDTs are construed to be successful only if they support the complete design trajectory from specification to implementation and testing, and if they succeed in faithfully reflecting the design concerns of this design trajectory. The need to integrate formal methods and design methods is emphasized. ESA

N91-18638# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
REPORT ON LOTOSPHERE AFTER ONE YEAR
Joeren vandeLagemaat and Chris A. Vissers 12 Sep. 1990 13 p
(Proj. 2304)
(MEMO-INF-90-48; ISSN-0923-1714; ETN-91-98665) Avail: NTIS HC/MF A03

The LOTOSPHERE project started in April 1990 and is aimed at the exploitation by industry of mathematically sound formal design techniques. A fully tool-supported formal system design and development methodology is engineered and exercised. The project is organized in three workpackages. One on methodology development, one on tool and one on the industrial application of the methodology and tools on realistic applications. After one year the results are as follows: the design structuring methodology was developed covering most abstract aspects on design and development and practical guidelines on specification structures; transformations to be used within the design trajectory are identified and for some algorithms are given; an assessment of current testing methods was made; a first version of a tool set was distributed to all partners; for all applications realistic specifications were made serving as a basis for implementation and providing the first feedback on methodology, language and tools. In the immediate future the project will refine and extend the methodology including transformations and testing, and providing more guidance on its application. New versions of the toolset will be made available providing additional functionality in accordance with the method and its application. Industrial implementions will be made in the areas of OSI (Open System Interconnection) and ISDN (Integrated Services Digital Networks). ESA

N91-18639# Universiteit Twente, Enschede (Netherlands). Tele-Informatics Group.
STEP-WISE REFINEMENT DESIGN EXAMPLE USING LOTOS
Luis FerreiraPires and Wanderley LopesdeSouze (Universidade Federal de Paraiba, Brazil) Oct. 1990 20 p Sponsored in part by EEC and Conselho Nacional de Pesquisas, Brazil
(MEMO-INF-90-55; ISSN-0923-1714; ETN-91-98671) Avail: NTIS HC/MF A03

The importance of a design methodology when using formal description techniques is generally agreed in the scientific community. Some design principles and concepts that characterize a step wise refinement design approach are presented and their application on an example of a mutual exclusion access system is discussed. The relevance of this work is to provide a reference as to how design decisions during the design trajectory can be taken and represented in LOTOS (Language Of Temporal Ordering Specification) specifications, and to evaluate the suitability of such techniques for use on an industrial scale. ESA

N91-18640# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OPTIMIZING THE CONTROLPATH OUTPUT FUNCTION OF INSTRUCTION SET PROCESSORS
A. J. W. M. tenBerg Oct. 1990 13 p
(MEMO-INF-90-57; ISSN-0923-1714; ETN-91-98672) Avail: NTIS HC/MF A03

A method for reducing the size and delay of microprogrammed controlpaths is presented. The method is developed for controlpaths of instruction set processors and performs especially well for Complex Instruction Set (CISC) designs. This method consists of two steps. First a decomposition is performed of the microprogrammed ROM (Read Only Memory) into control field specific PLA's (Programmable Logic Arrays). Due to the limited functionality of a control field, each of these PLA's contains large numbers of equal output values. In the second step this knowledge is used to minimize the number of product terms in each of the PLAS's by a re-assignment of state codes. A heuristic is presented which performs this state assignment by translations of state codes inside the full addressed range. Significant reductions in size and delay are obtained in comparison to horizontal microprogrammed ROM's. The side effects of this state assignment for the transition or sequencing function in the controlpath is discussed. ESA

N91-18641# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FAULT TOLERANT COMPUTING WITH TRANSPUTERS AND OCCAM
L. M. J. Nieuwenhuis (Dutch Post Office, Dr. Neher Lab., Leidschendam.) and G. D. Blom Oct. 1990 18 p
(MEMO-INF-90-59; ISSN-0923-1714; ETN-91-98674) Avail: NTIS HC/MF A03

A systematic approach for the design and implementation of fault tolerant systems is studied. The results of a case study with transputers and OCCAM for a systematic approach of fault tolerant computing are presented. An arbitrary transputer system can be transformed into a fault tolerant version without using additional special hardware. Fault tolerance is based on software implemented replication. The fault tolerant version consists of copies of the original system. Processes on the original transputers can automatically be transformed into versions which can be executed by the transputers of the fault tolerant system. The reliability of the resulting system is optimal and performance optimizing properties of the original system are presented. ESA

N91-18642# Universiteit Twente, Enschede (Netherlands). Tele-Informatics Group.
GENERIC SERVICE AND PROTOCOL STRUCTURES
Marten vanSinderen Oct. 1990 22 p Sponsored in part by EEC
(Proj. 2304; Proj. LOTOSPHERE)
(MEMO-INF-90-61; ISSN-0923-1714; ETN-91-98675) Avail: NTIS HC/MF A03

Service and protocol structures are presented in the context of design methodology, referred to as the LOTOSPHERE design methodology. The methodology provides a basis for motivating and refining specification structures. Some structuring principles are outlined and applied to generic service and protocol design. The resulting structures are expressed in the formal description technique LOTOS (Language of Temporal Ordering Specification). The usefulness of predefined specification structures in the architectural phase of distributed system design is discussed. ESA

N91-18643# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OVERVIEW OF THE LOTOSPHERE DESIGN METHODOLOGY
Luis FerreiraPires and Chris A. Vissers Oct. 1990 17 p
(Proj. 2304; Proj. LOTOSPHERE)
(MEMO-INF-90-64; ISSN-0923-1714; ETN-91-98677) Avail: NTIS HC/MF A03

The direction of work in the LOTOSPHERE design methodology is presented. Some basic concepts in distributed systems' design are examined and areas for further research and development are identified. The needs of the design process for distributed systems are defined and analyzed in order to determine how the use of a formal design language such as LOTOS (Language Of Temporal Ordering Specification) can improve this process. A top down view of the design trajectory is used in order to introduce the design goals, and related definitions and concepts. In this context, the role of abstraction is discussed as the concept that supports step wise refinement, and the role of design languages is discussed as the means to represent the relevant properties of a system. A more elaborated design trajectory takes into consideration the deviation cases from the straight top down model. This analysis ends up at the level of design steps, at which design concerns are identified as the areas of interest: the design methods that comprise the methodology. The study intends to provide a

framework for the effective use of formal description techniques in distributed system design, which is to be applied in the scope of the ESPRIT 2 LOTOSPHERE Project. ESA

N91-18644# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A CUTTING-PLANE APPROACH TO THE EDGE-WEIGHTED MAXIMAL CLIQUE PROBLEM
G. Dijkhuizen and U. Faigle Jul. 1990 25 p
(MATHS-MEMO-874; ISSN-0169-2690; ETN-91-98681) Avail: NTIS HC/MF A03

The computational performance of a cutting plane algorithm for the problem of determining a maximal subclique in an edge weighted complete graph is investigated. The numerical results are contrasted with reports on closely related problems for which cutting plane approaches perform well in instances of moderate size. The approach in the case of $n = 15$ or $n = 25$ nodes in the underlying graph typically produces neither an integral solution nor yields a good approximation to the true optimal objective function value. This result seems to shed some serious doubt on the universal applicability of cutting plane approaches as an efficient means to solve linear (0,1) programming problems of moderate size. ESA

N91-18645# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
KNOWLEDGE GRAPHS VERSUS CONCEPTUAL GRAPHS
M. Willems Aug. 1990 28 p
(MATHS-MEMO-876; ISSN-0169-2690; ETN-91-98683) Avail: NTIS HC/MF A03

Two knowledge representation formalisms based on graphs are compared particularly with respect to their use for natural language semantics. A natural language model in terms of knowledge graphs, that has three main processes: activation, contraction, and generalization is described. The features of conceptual graphs: the type hierarchy, the conformity relation, the canonical derivation rules, the generalization relation, and the important maximal join are all proved to be present in the knowledge graph model. ESA

N91-18646# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
THREE DIMENSIONAL RECONSTRUCTION OF CLOSED OBJECTS BY PIECEWISE CUBIC TRIANGULAR BEZIER PATCHES
Claudia Cottin (Duisburg Univ., Germany, F.R.) and Ruud vanDamme Sep. 1990 20 p
(Grant DFG-Co-153/3-1)
(MATHS-MEMO-885; ISSN-0169-2690; ETN-91-98686) Avail: NTIS HC/MF A03

The problem of constructing a simple visually smooth (VC1) surface which interpolates to position values and normal vectors in a number of randomly distributed points on a closed object is considered. It is known that such interpolants can be obtained by building up three quartic polynomial patches on each element of some triangulation with vertices in the data points. By some essential, but easily implemented modifications of this method, one can restrict oneself to the use of cubic patches. ESA

N91-18647# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THREE LOGICS FOR BRANCHING BISIMULATION
Rocco DeNicola (Consiglio Nazionale delle Ricerche, Pisa, Italy) and Frits W. Vaandrager Jun. 1990 31 p Sponsored in part by EEC and CNR
(CWI-CS-R9012; ETN-91-98700) Copyright Avail: NTIS HC/MF A03

Three temporal logics are introduced which induce on labeled transition systems the same identifications as branching bisimulation. The first is an extension of Hennessy-Milner logic with a kind of until operator. The second is another extension of Henessy-Milner logic which exploits the power of backward modalities. The third is CTL(*) without the next time operator interpreted over all paths, not just over maximal ones. A relevant side effect of the last characterization is that it sets a bridge between the state and action based approaches to the semantics of concurrent systems. ESA

N91-18648# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
COMPARATIVE SEMANTICS FOR A PARALLEL CONTEXTUAL PROGRAMMING LANGUAGE
Jean-Marie Jacquet and Luis Monteiro (Universidade Nova de Lisboa, Portugal) May 1990 27 p Sponsored in part by EEC and Inst. Nacional de Investigacao Cientifica
(CWI-CS-R9018; ETN-91-98702) Copyright Avail: NTIS HC/MF A03

Recently, contextual logic programming was proposed as an extension to the logic programming paradigm aiming at structuring programs and logical derivations in a coordinated way. A study aimed at presenting and comparing various semantics for a parallel version of it is presented. Six semantics, ranging in the operational, declarative and denotational types, are discussed. Three operational semantics are presented. They all rest on a transition system but differ in their ability of describing success set, failure set, infinite computations and of handling repetitions: the first describes the set of atoms having a successful bottom up derivation; the second precises the computed answer substitutions; the third characterizes infinite derivations. As far as the declarative semantics are concerned, a model theoretic and a fixed point semantics are examined. They extend the Herbrand interpretation and the immediate consequence operator to the contextual framework. A denotational semantics based on processes, structured as trees, is given. The mathematical tools mainly used for these semantics are complete lattices for the declarative semantics and metric spaces for the other ones. The parallel logic language under consideration is an elementary one: it uses or-parallelism and and-parallelism in an unrestricted manner. A reconciliation calculus is provided as a way of combining substitutions resulting from the reductions of conjoined goals. Despite its simplicity, it is believed that the parallel language still constitutes a model of interest: the results obtained on it (in particular, the semantical ones) are bases for results about more elaborated and more practical concurrent versions. ESA

N91-18649# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
FROM FAILURE TO SUCCESS: COMPARING A DENOTATIONAL AND A DECLARATIVE SEMANTICS FOR HORN CLAUSE LOGIC
F. S. deBoer, J. N. Kok, C. Palamidessi (Pisa Univ., Italy), and J. J. M. M. Rutten May 1990 23 p Sponsored in part by EEC and Dutch Research and Education in Concurrent Systems Project
(CWI-CS-R9019; ETN-91-98703) Copyright Avail: NTIS HC/MF A03

The most basic example of a (parallel) logic programming language is Horn Clause Logic (HCL). A study aimed at relating different models for HCL, operational, denotational, declarative, is presented. Their relationship is studied by contrasting models based on interleaving, on the one hand, to models based on maximal parallelism, on the other. Complete metric spaces are made use of as an important mathematical tool, both in defining and in comparing the various models. ESA

N91-18650# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
BACK AND FORTH BISIMULATIONS
Rocco DeNicola, Ugo Montanari (Pisa Univ., Italy), and Frits W. Vaandrager May 1990 17 p Sponsored in part by EEC
(ESPRIT Proj. 3011; RACE Proj. 1046; ESPRIT Proj. 3006; Proj. CEDISYS; Proj. CONCUR)
(CWI-CS-R9021; ETN-91-98705) Copyright Avail: NTIS HC/MF A03

Bisimulation relations which do not only require related agents to simulate each others behavior in the direction of the arrows,

but also to simulate each other when going back in history are studied. First it is demonstrated that the back and forth variant of strong bisimulation leads to the same equivalence as the ordinary notion of strong bisimulation. Then it is shown that the back and forth variant of Milner's observation equivalence is different from (and finer than) observation equivalence. In fact it is proved to concide with the branching bisimulation equivalence of Van Glabeek and Weijland. Also the back and forth variants of branching, eta and delay bisimulation lead to branching bisimulation evidence. The notion of back and forth bisimulation moreover leads to characterizations of branching bisimulation in terms of abstraction homomorphisms and in terms of Hennessy-Milner logic with backward modalities. The results are suggested to support the claim that branching bisimulation is a natural and important notion. ESA

N91-18651# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
SOME ALGORITHMS ON ADDITION CHAINS AND THEIR COMPLEXITY
Matthijs J. Coster Jun. 1990 72 p
(CWI-CS-R9024; ETN-91-98707) Copyright Avail: NTIS
HC/MF A04

Twelve algorithms for calculating addition chains, addition sequences and vector addition chains are considered. The algorithms are compared on two criteria, namely the length of the chains/sequences and the memory usage. To do this, two techniques are used. The first involves a kind of addition chain graph, which is an important tool for studying the memory use in more detail. The second technique concerns a way to split up the chains and sequences into subsets that can be studied independently. Using number theoretical tools (especially from ergodic theory), some new results on upper bounds and average values for the lengths of chains and sequences are achieved. The algorithms are compared using some tables, described in detail, and an example is included for most of the algorithms. ESA

N91-18652# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
GENERALIZING COMPLETENESS RESULTS FOR LOOP CHECKS
Roland N. Bol Jun. 1990 32 p Sponsored in part by EEC
(CWI-CS-R9025; ETN-91-98708) Copyright Avail: NTIS
HC/MF A03

Loop checking is a mechanism for pruning infinite SLD derivations. Simple loop checks were previously introduced and their soundness, completeness and relative strength were studied. Since no sound and complete simple loop check exists even in the absence of function symbols, subclasses of programs were determined for which the (sound) loop checks introduced previously are complete. A study which proves the generalization theorem is presented. This theorem presents a method to extend (under certain conditions) a class of programs for which a given loop check is complete to a larger class, for which the loop check is still complete. The theorem is applied to the previous results, giving rise to stronger completeness theorems. It appears that unnecessary complications in the proof of the theorem can be avoided by introducing a normal form for SLD derivations, allowing only certain most general unifiers. This normal form might have other applications than those in the area of loop checking. ESA

N91-18653# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
TOWARDS MORE EFFICIENT LOOP CHECKS
Roland N. Bol Jun. 1990 21 p Presented at North American Conference on Logic Programming, 1990 Submitted for publication Sponsored in part by EEC
(CWI-CS-R9026; ETN-91-98709) Copyright Avail: NTIS
HC/MF A03

Loop checking is a mechanism for pruning infinite SLD derivations. Most loop checks essentially compare the goals in a derivation: a derivation is pruned if sufficiently similar goals are detected. In theory a goal is usually compared with every previous goal in the derivation, but in practice such loop checks are too expensive. The alteration of such loop checks to obtain less expensive ones (notably such that the number of comparisons performed is linear in the number of goals generated) while retaining the soundness and completeness results of the original loop check is investigated. To this end, Van Gelder's tortoise and hare technique is modified and the number of comparisons performed by a loop check whose checkpoints are placed in accordance with the triangular numbers is studied in detail. ESA

N91-18654# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
FULLY ABSTRACT DENOTATIONAL MODELS FOR NONUNIFORM CONCURRENT LANGUAGES
E. Horita, J. W. deBakker (Vrije Univ., Amsterdam, Netherlands), and J. J. M. M. Rutten Jun. 1990 58 p Sponsored in part by EEC
(CWI-CS-R9027; ETN-91-98710) Copyright Avail: NTIS
HC/MF A04

Full abstractness of denotational models with respect to operational ones for two concurrent languages is investigated. The languages are nonuniform in the following sense: they have individual variables which store values, and the elementary actions are (mainly) value assignments to these variables. The first language L1 has parallel composition but no communication, whereas the second one L2 has CSP-like communications in addition. For each of Li (i = 1, 2), an operational model Oi is introduced in terms of a Plotkin-style transition system, while a denotational model Di for Li is defined compositionally using interpreted operations of the language, with meanings of recursive programs as fixed points in appropriate complete metric spaces. The full abstractness is shown by means of a context with parallel composition: given two statements s1 and s2 with different denotational meanings, a suitable statement T is constructed such that the operational meanings of (s1 is equivalent to T) and (s2 is equivalent to T) are distinct. A combinatorial method for constructing such T is proposed. Thereby the full abstractness of D1 and D2 with respect to O1 and O2 respectively is established. That is, Di is most abstract of those models C which are compositional and satisfy Oi = alpha circle C for some abstraction function alpha (i = 1, 2). ESA

N91-18655# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
ON THE ROLE OF DELEGATION AND INHERITANCE IN OBJECT-ORIENTED DATABASE SYSTEMS
D. B. M. Otten and P. J. W. tenHagen Jul. 1990 21 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-CS-R9032; ETN-91-98715) Copyright Avail: NTIS
HC/MF A03

Research in the field of Computer Aided Design (CAD) is often directed towards the use of artificial intelligence and logic programming techniques. For instance, the use of backward and forward reasoning, reasoning with uncertainty and default reasoning. Research directed towards the object oriented paradigm is being developed. It focuses on the development of CAD systems with respect to: the evolutionary character of the design process; the parallel exploration of possible solutions of the design; and the integration of knowledge of other domains during the design process. Inheritance and delegation, two communication concepts between objects, are believed to be important mechanisms for representing CAD information subjected to the above mentioned issues. Although both mechanisms address the same goal, delegation is believed to better suit the requirements of design support. Both mechanisms are already implemented in many systems. However, the objects and their relationships are maintained in main memory and are not supported by a secondary storage device. A database management system which is based on the use of these inheritances and delegations is being developed. With these mechanisms it is expected that more complex structured information and knowledge about design

processes and designed artifacts can be stored and maintained. The conceptual differences between both mechanisms are explained as well as some of their implementational issues. ESA

N91-18656# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
METRIC POMsets SEMANTICS FOR A CONCURRENT LANGUAGE WITH RECURSION
J. W. deBakker and J. H. A. Warmerdan Jul. 1990 23 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-CS-R9033; ETN-91-98716) Copyright Avail: NTIS HC/MF A03

The semantics of a simple language with concurrency and recursion are studied. The semantic domain consists of (sets of) finite and infinite Partially Ordered Multisets (POMsets) in order to model true concurrency (i.e., noninterleaved parallel execution). It is shown that the set of POMsets can be turned into a complete ultrametric space. With the induced notion of convergence, it is possible to provide meaning to infinite computations. Operational and denotational semantics for the considered language are provided and their equivalence is established by showing that both are fixed points of a contracting higher order operator. A tentative denotational semantics for an extension of the language with synchronization is given. ESA

N91-18657# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
MODULES IN LORE: NOTES ON THE IMPLEMENTATION
Bob Goedhart, Fred terHaar, and Willem Jonker 1990 27 p
(REPT-90-64; ISSN-0922-5641; ETN-91-98741) Copyright Avail: NTIS HC/MF A03

The maker, compiler and linker of the logic based programming environment LORE are described. Emphasis is placed on the introduction of modules and their effect on the implementation. The maker analyzes the dependencies between modules. The compiler takes a LORE module as unit of compilation, this allowing incremental program development and construction of libraries. The linker combines all modules into an executable file that can be run by the interpreter. This interpreter is described in a separate report. ESA

N91-18658# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
LANGUAGE RECOGNITION BY NONPROPAGATING CELLULAR AUTOMATA
T. Jebelean 1990 22 p
(REPT-90-73; ISSN-0922-5641; ETN-91-98750) Copyright Avail: NTIS HC/MF A03

One way Linear Cellular Automata (OLCA) recognition ability is examined is by considering their nonpropagating variant (cells are allowed to disappear during the computation). Comparison with standard OLCA, hardware implementation, real time and constant time recognition, and closure properties of nonpropagating OLCA languages are investigated. ESA

N91-18659# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
KRAMES ROTATIONS: CHARACTERIZATION OF THE ROTATIONS REPRESENTED BY STRAIGHT LINES IN STEREOGRAPHIC SPACE
J. E. Mebius 1990 12 p
(REPT-90-76; ISSN-0922-5641; ETN-91-98753) Copyright Avail: NTIS HC/MF A03

The three dimensional rotations represented by straight lines in stereographic space, or alternatively, by circles in the quaternion unit sphere, are characterized. They are recognized as special cases of Krames motions. The connection with three dimensional computer graphics is explained. ESA

N91-18660# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
THE POWER ALGORITHM IN MAX ALGEBRA
J. G. Braker and G. J. Olsder 1990 19 p
(REPT-90-78; ISSN-0922-5641; ETN-91-98755) Copyright Avail: NTIS HC/MF A03

It is proved that, under certain conditions, an algorithm like the power algorithm in conventional linear algebra can be used to find the eigenvector and eigenvalue of a max-algebra system. If the conditions are not satisfied the eigenvector can be found using an extension of the power algorithm. ESA

N91-18661# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
CALCULATION BY COMPUTER: OVERVIEW
Paul Chisholm 1990 20 p
(Grant SION-612-317-019/21)
(CS-9007; ETN-91-98757) Avail: NTIS HC/MF A03

A system providing support for interactive proof construction is described. The main concern is calculational (or transformational) style proof development, but a form of bottom up natural deduction proof is also supported. The principles upon which the system is based are that it be flexible and easy to use, that proof is viewed as a syntactic editing process, and that the user decides the level of detail of a proof. Consequently, a traditional constraint of proof editors, that proof be machine checkable, is not enforced. ESA

N91-18662# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
SOME ALGORITHMS FOR THE APPROXIMATION OF INVARIANT TORI
H. Bruin 1990 24 p
(W-9008; ETN-91-98761) Avail: NTIS HC/MF A03

Algorithms by M van Veldhuizen are discussed and extended. The algorithms approximate invariant 2-tori of ordinary differential equations and are based on the stability of these tori and the existence of a Poincare map. In the theoretical part systems having parallel flow on the torus, and small perturbations of these are treated. Families of time driven and coupled Van der Pol equations serve as a numerical illustration of the theory. ESA

N91-18663*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
USING PROCESS GROUPS TO IMPLEMENT FAILURE DETECTION IN ASYNCHRONOUS ENVIRONMENTS
Aleta M. Ricciardi and Kenneth P. Birman 7 Feb. 1991 35 p Sponsored in part by IBM and Siemens A.G.
(Grant NAG2-593)
(NASA-CR-187978; NAS 1.26:187978; TR-91-1188) Avail: NTIS HC/MF A03 CSCL 09B

Agreement on the membership of a group of processes in a distributed system is a basic problem that arises in a wide range of applications. Such groups occur when a set of processes cooperate to perform some task, share memory, monitor one another, subdivide a computation, and so forth. The group membership problems is discussed as it relates to failure detection in asynchronous, distributed systems. A rigorous, formal specification for group membership is presented under this interpretation. A solution is then presented for this problem.
Author

N91-18664*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
TOOLS FOR MONITORING AND CONTROLLING DISTRIBUTED APPLICATIONS
Keith Marzullo and Mark D. Wood Feb. 1991 18 p Sponsored in part by Xerox Corp. and GTE Sylvania, Inc.
(Contract NAG2-593; N00140-87-C-8904)
(NASA-CR-187977; NAS 1.26:187977; TR-91-1187) Avail: NTIS HC/MF A03 CSCL 09B

The Meta system is a UNIX-based toolkit that assists in the construction of reliable reactive systems, such as distributed monitoring and debugging systems, tool integration systems and reliable distributed applications. Meta provides mechanisms for instrumenting a distributed application and the environment in which it executes, and Meta supplies a service that can be used to

monitor and control such an instrumented application. The Meta toolkit is built on top of the ISIS toolkit; they can be used together in order to build fault-tolerant and adaptive, distributed applications. Author

N91-18665*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
LIGHTWEIGHT CAUSAL AND ATOMIC GROUP MULTICAST
Kenneth P. Birman, Andre Schiper (Ecole Polytechnique Federale de Lausanne, Switzerland), and Pat Stephenson 21 Feb. 1991 47 p Sponsored in part by GTE Sylvania, Inc.; IBM; and Siemens A.G.
(Grant NAG2-593)
(NASA-CR-187976; NAS 1.26:187976; TR-91-1192) Avail: NTIS HC/MF A03 CSCL 09B

The ISIS toolkit is a distributed programming environment based on support for virtually synchronous process groups and group communication. A suite of protocols is presented to support this model. The approach revolves around a multicast primitive, called CBCAST, which implements a fault-tolerant, causally ordered message delivery. This primitive can be used directly or extended into a totally ordered multicast primitive, called ABCAST. It normally delivers messages immediately upon reception, and imposes a space overhead proportional to the size of the groups to which the sender belongs, usually a small number. It is concluded that process groups and group communication can achieve performance and scaling comparable to that of a raw message transport layer. This finding contradicts the widespread concern that this style of distributed computing may be unacceptably costly. Author

N91-18666# CIAD, Zoetermeer (Netherlands).
[ACTIVITIES REPORT OF THE ASSOCIATION FOR COMPUTER APPLICATION IN ENGINEERING PRACTICE] Annual Report, 1989 [VERENIGING VOOR COMPUTERTOEPASSINGEN IN DE INGENIEURSPRAKTIJK, JAARVERSLAG 1989]
Jun. 1990 73 p In DUTCH
(ETN-91-98768) Avail: NTIS HC/MF A04

The activities of the Association in the following fields are summarized: computer integrated manufacturing; computer applications in civil engineering; automation aids in electronics and electrical engineering; computer calculations based on the finite element method; and knowledge systems. ESA

N91-18667# Oak Ridge National Lab., TN.
SUBPIXEL MEASUREMENT OF IMAGE FEATURES BASED ON PARABOLOID SURFACE FIT
S. S. Gleason, M. A. Hunt, and W. B. Jatko 1990 10 p Presented at the OPTCON 1990, Boston, 4-9 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE91-004777; CONF-9011125-5) Avail: NTIS HC/MF A02

A digital image processing inspection system is under development at ORNL that will locate image features on printed material and measure distances between them to accuracies of 0.001 in. An algorithm was developed for this system that can locate unique image features to subpixel accuracies. It is based on a least squares fit of a paraboloid function to the surface generated by correlating a reference image feature against a test image search area. Normalizing the correlation surface makes the algorithm robust in the presence of illumination variations and local flaws. Subpixel accuracies better than 1/16 of a pixel were achieved using a variety of different reference image features. DOE

N91-18668# Argonne National Lab., IL.
COMPUTER SIMULATION AND SCIENTIFIC VISUALIZATION
D. P. Weber and F. M. Moszur 1990 7 p Presented at the 1st Annual International Simulators Conference, New Orleans, 1-5 Apr. 1991
(Contract W-31-109-eng-38)
(DE91-006394; CONF-910468-3) Avail: NTIS HC/MF A02

The simulation of processes in engineering and the physical sciences has progressed rapidly over the last several years. With rapid developments in supercomputers, parallel processing, numerical algorithms and software, scientists and engineers are now positioned to quantitatively simulate systems requiring many billions of arithmetic operations. The need to understand and assimilate such massive amounts of data has been a driving force in the development of both hardware and software to create visual representations of the underling physical systems. In this paper, and the accompanying videotape, the evolution and development of the visualization process in scientific computing will be reviewed. Specific applications and associated imaging hardware and software technology illustrate both the computational needs and the evolving trends. DOE

N91-18669# Argonne National Lab., IL.
AN ARCHITECTURE FOR DEVICE INDEPENDENT INTERFACING
D. M. Pace 1990 10 p Presented at the 4th Annual Idaho National Engineering Laboratory Computing Symposium, Idaho Falls, 18-20 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-006451; CONF-9009177-1) Avail: NTIS HC/MF A02

Achieving device independence for software applications is required for all but a small number of critical real time applications. Device independence is achieved by establishing protocols and building protocol interpreters for the specific devices. Data structures containing pointers to functions provide a flexible architecture for implementing protocol translation. DOE

N91-18670# Lawrence Livermore National Lab., CA.
UNDERSTANDING LARGE SOFTWARE SYSTEMS WITH THE UTILITY XREG
C. E. Rhoades, Jr. 18 Nov. 1990 36 p
(Contract W-7405-eng-48)
(DE91-007630; UCRL-ID-106165) Avail: NTIS HC/MF A03

When a software system reaches a certain size, arteriosclerosis sets in. That is, the system becomes harder and harder to add new features and even more difficult to understand. Worse, the insertion of new features often introduces new programming errors as well as revealing ones already present but previously unmanifested. For FORTRAN programs, the 100,000 line size is critical. XREF fights hardening of the arteries by providing the user information on the organization, variable usage, and common block use within the software system. XREF is language independent. That is, it works, for example, with CAL, C, CIVIC, and CFT compiled subprograms. XREF performs its global symbol analysis from either the BUILD library file or the object (binary) file. Naturally more useful information is obtained when a symbol table is generated by the compiler. Specifically, eight global reports are produced. The most helpful report consists of a listing of all symbols contained in the BUILD library or binary file, the subprograms that use the symbol and the relocation basis (either local or common block name) of each symbol. Five secondary reports are provided for each subprogram. DOE

N91-18671# Lawrence Livermore National Lab., CA.
TOWARDS A TESTBED FOR MALICIOUS CODE DETECTION
R. Lo, P. Kerchen, R. Crawford, W. Ho, J. Crossley, G. Fink, K. Levitt, R. Olsson, and M. Archer (California Univ., Davis.) 1991 9 p Presented at the COMPCON '91, San Francisco, 25 Feb. - 1 Mar. 1991
(Contract W-7405-eng-48)
(DE91-007632; UCRL-JC-105792; CONF-910263-7) Avail: NTIS HC/MF A02

This paper proposes an environment for detecting many types of malicious code, including computer viruses, Trojan horses, and time/logic bombs. This malicious code testbed (MCT) is based upon both static and dynamic analysis tools developed at the University of California, Davis, which have been shown to be effective against certain types of malicious code. The testbed extends the usefulness of these tools by using them in a complementary fashion to detect more general cases of malicious code. Perhaps more importantly, the MCT allows administrators and security analysts to check a program before installation, thereby avoiding any damage a malicious program might inflict. DOE

N91-18317*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
EMERGING STANDARDS FOR STILL IMAGE COMPRESSION: A SOFTWARE IMPLEMENTATION AND SIMULATION STUDY
F. Pollara and S. Arnold *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 98-102 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 09B

N91-18991*# Centre Coll. of Kentucky, Danville. Dept. of Mathematics and Science.
REDUCTION OF SOLAR VECTOR MAGNETOGRAPH DATA USING A MICROMSP ARRAY PROCESSOR
Jack Kineke *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

N91-18995*# Harding Coll., Searcy, AR. Dept. of Physical Science.
TEST IMAGES FOR THE MAXIMUM ENTROPY IMAGE RESTORATION METHOD
James E. Mackey *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 09B

N91-19004*# West Virginia Inst. of Tech., Montgomery. Dept. of Electrical Engineering.
DEVELOPMENT OF SEDS DATA SYSTEM FLIGHT SOFTWARE
William E. Pierson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

N91-19018*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
GRAPHICS MODELLING OF NON-CONTACT THICKNESS MEASURING ROBOTICS WORK CELL
Charles W. Warren *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N91-18672# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Equipe Outils et Logiciels pour la Communication.
INTERCONNECTION OF COMPUTER NETWORKS AND INTEGRATED SERVICES DIGITAL NETWORKS: MODELIZATION AND VERIFICATION OF ARCHITECTURES OF COMMUNICATION Ph.D. Thesis - Toulouse Univ. [INTERCONNEXION DE RESEAUX INFORMATIQUES ET RESEAU NUMERIQUE A INTEGRATION DE SERVICES: MODELISATION ET VERIFICATION D'ARCHITECTURES DE COMMUNICATION]
Cecile Faure 1990 150 p In FRENCH; ENGLISH summary
(LAAS-90344; ETN-91-98589) Avail: NTIS HC/MF A07

Computer networks interconnection is studied. By taking account of the network architectures, fundamental concepts are highlighted, namely the incompatibility notion which regroups addressing and heterogeneous issues, and frontier of incompatibility. Two different types of implementation were considered for the interconnection of two or more networks: centralized and decentralized interconnections. These principles are illustrated in examples allowing networks of classical architecture to link to or through the ISDN (Integrated Services Digital Network) with common channel signalling. Two modeling and verification examples are studied: the main mechanisms of ISDN signalling protocol (layer 3), and LAPD (layer 2); and the design of gateway architecture. The use of predicate transition nets and of verification by abstraction methods based on string equivalence, observational equivalence and behavior equivalence, are highlighted. ESA

N91-18673# Sandia National Labs., Albuquerque, NM.
TUNING COMPUTER COMMUNICATIONS NETWORKS AND PROTOCOLS
Edward L. Witzke (Proteus, Inc., Albuquerque, NM.) and Lyndon G. Pierson 1991 8 p Presented at the International Phoenix Conference on Computers, Phoenix, AZ, 27-30 Mar. 1991
(Contracts DE-AC04-76DP-00789; SNL-56-4351)
(DE90-012764; SAND-90-1705C; CONF-910313-1) Avail: NTIS HC/MF A02

Current computer network protocols are very robust and capable of being used in a variety of different environments. Typically, the implementations of these protocols come to the user with preset parameters that provide reasonable performance for low delay bandwidth product environments with low error rates, but these defaults do not necessarily provide optimal performance for high delay bandwidth, high error rate environments. To provide optimal performance from the user's perspective, which is application to application, all equivalent layers of the protocol must be tuned. The key to tuning protocols is reducing idle time on the links caused by various protocol layers waiting for acknowledgments. The circuit bandwidth, propagation delay, error rate, number of outstanding packets, buffer length, number of buffers, and buffer size can all affect the observed idle time. Experiments were conducted on test bed systems, and on live satellite and terrestrial circuits. Observations from these experiments led the authors to draw conclusions about the locations of common bottlenecks. Various aspects of network tuning and certain specific issues relating to the tuning of three protocols (DECnet, TCP/IP, NETEX) over various media types (point-to-point and broadcast) under several different conditions (terrestrial and satellite) are examined. Also described are the lessons learned about protocol and network tuning. DOE

N91-18674# Lawrence Livermore National Lab., CA. Massively Parallel Computing Initiative Div.
GAUSS ELIMINATION: A CASE STUDY ON PARALLEL MACHINES
Karen H. Warren and Eugene D. Brooks, III Nov. 1990 7 p Presented at the COMPCON 1991, San Francisco, CA, 25 Feb. - 1 Mar. 1991 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006259; UCRL-JC-105426; CONF-910263-4) Avail: NTIS HC/MF A02

We report our experiences with the Gauss elimination algorithm on several parallel machines. Several different software designs are demonstrated, ranging from a simple shared memory implementation to use of a message passing programming model. In this work we find that the efficient use of local memory is critical to obtaining good performance on scalable machines. Machines with large coherent caches appear to require the least software effort in order to obtain effective performance. DOE

N91-18675# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DISTRIBUTED DATA BASES: PARALLELISM AND COMPLEX OBJECTS
Wouter B. Teeuw May 1990 22 p
(MEMO-INF-90-22; ISSN-0923-1714; ETN-91-98650) Avail: NTIS HC/MF A03

There is a need for representing and manipulating complex objects in distributed database systems. The parallel manipulation of complex objects in a shared nothing environment is studied. A view on parallelism and on complex objects, and an overview of some database systems that are either shared nothing or handle

complex objects are given. Future research intentions include the input/output bottleneck, data allocation and storage issues and parallel processing. ESA

N91-18676# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FORMAL DESCRIPTION TECHNIQUES FOR DISTRIBUTED COMPUTING SYSTEMS, THE CHALLENGES FOR THE 1990'S
Chris A. Vissers, Joeren vandeLagemaat, and Luis FerreiraPires Jun. 1990 9 p Sponsored in part by EEC
(MEMO-INF-90-31; ISSN-0923-1714; ETN-91-98657) Avail: NTIS HC/MF A02

Initially FDTs (Formal Description Techniques) were developed for specification, at a high level of abstraction, of distributed systems. Research is being performed on the use of FDTs to support the complete implementation trajectory. A number of such research activities that are conducted within the framework of the LOTOSPHERE project are discussed. Aspects of design methodology, correctness preserving transformation, the reflection of design criteria, the role of predefined specification and implementation constructs, and the formal approaches to conformance testing are discussed. Some insight is given in the development of the comprehensive toolset that supports these aspects of design methodology. Experience obtained from the application of these methods and tools to some realistic pilot implementations, an ISDN (Integrated Services Digital Network) and MHS application and a transaction processing application, are given in conclusion. ESA

N91-18677# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A HIGH-SPEED SLOTTED RING ACCESS MECHANISM WITH DYNAMICALLY ADAPTIVE SLOT SIZES
H. L. Pasch and Ignas G. Niemegeers Jun. 1990 18 p
(MEMO-INF-90-36; ISSN-0923-1714; ETN-91-98660) Avail: NTIS HC/MF A03

Two access methods for Local Area Networks (LANs), the slotted and the token ring are analyzed with focus on differences in performance. Transfer delay has become a concern in the performance of LANs and High Speed LANs (HSLANs) since there is uncertainty about the characteristics and the mix of future (broadband) traffic and it is important to search for networks which can adapt to the traffic characteristics. The basic concepts of a network called Universal Channels Network (UCN), which is aimed at HSLANs and Metropolitan Area Networks (MANs) are introduced. This network is argued to combine the advantages of the slotted and the token ring, by making the mechanism that causes the difference in performance adaptive. A useful feature of UCN, the transmission interrupt mechanism, which assures that the performance is not only good for a single application to which the network parameters are adapted, but also for a mix of applications is described. Conclusions and open issues on UCN are given. ESA

N91-18678# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
PARALLEL INCREMENTAL ATTRIBUTE EVALUATION
Henk Alblas Aug. 1990 14 p
(MEMO-INF-90-42; ISSN-0923-1714; ETN-91-98662) Avail: NTIS HC/MF A03

The field of parallel compilation is discussed and a study on parallel incremental attribute evaluation is presented. The design of a concurrent incremental combined static/dynamic attribute evaluator is presented. The static part is an incremental version of the ordered attribute evaluation scheme. The dynamic part is an incremental version of the dynamic evaluation scheme. To remove the restriction that every transformation of an attributed syntax tree should immediately be followed by a re-evaluation of the tree, criteria are formulated which permit a delay in calling the reevaluator. These criteria allow multiple asynchronous tree transformations and multiple asynchronous re-evaluations. Transformation and re-evaluation processes are distributed over regions of the tree. Each region is either in its transformation phase or in its re-evaluation phase. Different regions can be in different phases at the same time. ESA

N91-18679# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THREE-PHASE PARALLEL JOIN MODEL
Wouter B. Teeuw, Henk M. Blanken, and Bert R. M. vandenAkker 13 Sep. 1990 35 p
(MEMO-INF-90-49; ISSN-0923-1714; ETN-91-98666) Avail: NTIS HC/MF A03

Research on parallel relational database machines is discussed. A three phase parallel join model is presented. The model provides a systematic method to compare different join methods in a shared nothing database machine with horizontal partitioning of relations. The model can be used to build an optimizer that chooses the most suitable join method. Moreover the cost for different phases in the join algorithm can be investigated. It appears that the larger part of the total response time is needed for disk input/outputs. ESA

N91-18680# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
PERFORMANCE ANALYSIS OF GENERIC SYSTEM ARCHITECTURES
S. Kloostra 10 Sep. 1990 168 p
(Proj. 890; Proj. PANGLOSS)
(MEMO-INF-90-51; ISSN-0923-1714; ETN-91-98667) Avail: NTIS HC/MF A08

In the framework of the development of a design methodology for distributed, concurrent systems, and proof of this methodology by the design of a high performance gateway, the development of a Generic System Architecture (GSA) is described. The GSAs are intended to be a platform between the high level description or user requirements of an implementation and the realization. The developed GSAs represent possible implementations of a gateway or switch. Generic is used in the sense that a lot of parameters are still left open. However, the interrelation of the resources has been determined. Four GSAs are developed, each with its own specific characteristics. Performance analyses are carried out in order to examine these characteristics and to show the ranges where characteristic x is 'better' than characteristic y. Each GSA represents a class of switches. Showing the advantages of a specific GSA for a certain range of parameters implies that the corresponding class of switches will also be favorable with respect to other classes of switches in that specific range of parameters. Case studies show the ability of the GSAs to cover a large number of classes of switches. ESA

N91-18681# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SIMULATION MODELS OF THE GENERIC SYSTEM ARCHITECTURES
S. Kloostra 10 Sep. 1990 89 p
(MEMO-INF-90-52; ISSN-0923-1714; ETN-91-98668) Avail: NTIS HC/MF A05

Simulation models used for a performance assessment of four Generic System Architectures (GSAs) are described. The GSAs were developed within the framework of the development of a design methodology for distributed, concurrent systems, and proof of this methodology by the design of a high performance gateway. The GSAs are intended to be a platform between the high level description or user requirements of an implementation and realization. The simulation models were described in the performance analysis language QNAP2. The environment and the use of the simulation models are described. An example which shows the complete simulation route starting with the input through to the output for one simulation model is presented. ESA

N91-18682# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
COMMUNICATION ISSUES FOR PARALLEL SYSTEMS
Gerard J. M. Smit, Paul J. M. Havinga, and Pierre G. Jansen

Sep. 1990 47 p
(MEMO-INF-90-54; ISSN-0923-1714; ETN-91-98670) Avail: NTIS HC/MF A03

An important issue in the design of parallel systems is the interconnection network. This network is usually modeled by a graph, in which the vertices represent the switching element or processors and the edges represent communication links. Recent developments in Very Large Scale Inegration (VLSI) technology made it possible to interconnect a large number of computing elements. A list is presented of the most important topology related issues of communication networks for parallel processing such as: degree, diameter, regularity, modularity, mapping of algorithms, DSLI implementation and fault tolerance (bisection width, connectivity). Examples of interesting static and dynamic networks are given. Another important issue of parallel systems is the routing mechanism. Examples of routing mechanisms are store-and-forward, wormhole and virtual cut through. The routing mechanism has great impact on the performance (latency) of interprocessor communication. Furthermore routing algorithms may avoid deadlock situations and starvation. Deadlock occurs when no message can advance toward its destination because the queues of the message system are full. ESA

N91-18683# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
STATIC ALLOCATION OF PROCESS REPLICAS IN FAULT TOLERANT COMPUTING SYSTEMS
L. M. J. Nieuwenhuis (Dutch Post Office, Dr. Neher Lab., Leidschendam.) Oct. 1990 26 p
(MEMO-INF-90-58; ISSN-0923-1714; ETN-91-98673) Avail: NTIS HC/MF A03

A system is defined by processes, processors and allocation function mapping processes on processors. A system is tolerant for processor faults if proccesses are replicated and replicas are allocated to different processors. Obviously, system reliability depends on the reliability of the processors. However, the system reliability also strongly depends on the allocation of process replicas. It is proved that there exist allocations which are optimal with respect to reliability. A simple tranformation rule is presented which derives an optimal allocation of replicated systems from an allocation of a given nonreplicated system. This transformation preserves performance optimizing properties of the original allocation. Generally, replication gives a large number of processor links. A second transformation rule generates a replicated system with authenticated messages. The reliability of this system is also optimal however with significantly less communication links. ESA

N91-18684# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
MUTIPROCESSOR SCHEDULING WITH COMMUNICATION DELAYS
B. Veltman, B. J. Lageweg, and J. K. Lenstra (Technische Univ., Eindhoven, Netherlands) Jun. 1990 14 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9018; ETN-91-98729) Copyright Avail: NTIS HC/MF A03

Certain types of scheduling problems that arise when a parallel computation is to be executed on a multiprocessor are presented. A model that allows for communication delays between precedence related tasks, and proposes a classification of various submodels is defined. Complexity results and optimization and approximation algorithms that have been presented in the literature are reviewed. ESA

N91-18685# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
PARALLEL PROCESSING IN NUMBER-THEORETICAL PROBLEMS
H. J. J. teRiele Jun. 1990 11 p Presented at the Workshop on Parallel Processing, Bombay, India, 7-9 Feb. 1990 Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-NM-R9010; ETN-91-98735) Copyright Avail: NTIS HC/MF A03

Three classical problems in number theory are discussed. The Riemann hypothesis, the conjecture of Mertens, and the problem of finding the prime factors of a given larger integer are all considered. Thanks to the power of parallel and vector processing, it is shown to be possible to extend the state of knowledge concerning these problems by several orders of magnitude. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N91-18686# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Groupe Robotique et Intelligence Artificielle.
TEMPORAL REASONING FOR PLANNING AND SITUATION ASSESSMENT Ph.D. Thesis - Toulouse Univ.
Amine MounirAlaoui 1990 147 p In FRENCH; ENGLISH summary
(LAAS-90353; ETN-91-98590) Avail: NTIS HC/MF A07

A time map manager is developed, which uses time points as tokens and is the basis for a temporal reasoning system which uses temporal propositions. It was used in a planning system with two granularity levels (actions and tasks) for the description of its operators. A preprocessing was achieved to facilitate the planning system task and the corresponding planning algorithms were developed. Another application of the temporal reasoning system was made in the situation assessment field to recognize a particular situation in an evolutive environment. A formalism was developed to describe the situations as sets of facts or events temporally linked. ESA

N91-18687# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON A STATE SPACE APPROACH TO NONLINEAR H SUB INFINITY CONTROL
A. J. vanderSchaft Aug. 1990 18 p
(MATHS-MEMO-878; ISSN-0169-2690; ETN-91-98684) Avail: NTIS HC/MF A03

The standard H sub infinity optimal control problem using state feedback for smooth nonlinear control systems is studied. The main theorem obtained roughly states that the L sub 2 induced norm (from disturbances to inputs and outputs) can be made smaller than a constant gamma greater than 0 if the corresponding H sub infinity norm for the system linearized at the equilibrium can be made smaller than gamma by linear state feedback. Necessary and sufficient conditions for the latter problem are now well known, e.g., from the state space approach to linear H sub infinity optimal control. This state space approach to the nonlinear H sub infinity optimal control problem generalizes that state space solution to the linear problem by replacing the Hamiltonian matrix and corresponding Riccati equation as used in the linear context by a Hamiltonian vectorfield together with a Hamilton-Jacobi equation corresponding to its stable invariant manifold. ESA

N91-18688# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ON THE HAMILTON-JACOBI EQUATION OF NONLINEAR H SUB INFINITY OPTIMAL CONTROL
A. J. vanderSchaft Oct. 1990 13 p
(MATHS-MEMO-895; ISSN-0169-2690; ETN-91-98692) Avail: NTIS HC/MF A03

A state space approach to the nonlinear H(sub infinity) optimal control by state feedback previously initiated is elaborated. The underlying Hamilton-Jacobi equation, which forms the direct analog of a well known Riccati equation from linear H(sub infinity) optimal theory is focused upon. The nature of solutions to this equation,

in particular the existence of global solutions and consequently of globally defined feedbacks, is investigated through some simple examples. ESA

N91-18689# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
RESOLUTION AND LOGICAL CONSEQUENCES
Louis Kossen May 1990 14 p Sponsored by Netherlands Stimulerings-Projectteam Informatica-Ondezoek
(CWI-CS-R9023; ETN-91-98706) Copyright Avail: NTIS HC/MF A03

Completeness of binary resolution is defined in refutation form: if a set of clauses in first order logic is inconsistent, then the empty clause can be deduced by binary resolution. An extended completeness theorem for binary resolution is formulated and proved. It is proved that for each clause which is a non trivial logical consequence of a theory, a clause subsuming that clause can be generated by binary resolution. An extended completeness theorem is also formulated and proved for P sub 1 resolution. Furthermore it is shown how extended completeness can be applied to knowledge based systems. According to refutation completeness, resolution can be used to deduce a fact by refuting its negation. These refutation proofs are hard to understand. It is shown by extended completeness, that in the propositional case, resolution can be used to generate a set of so called non trivial minimal logical consequences together with an explanation of these consequences. This set also contains the facts which can be verified by means of refutation completeness. This approach contributes to better explanation facilities of knowledge based systems. ESA

N91-18690# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
REDUCED-ORDER CONTROL OF DIFFUSION/LPCVD REACTORS USING OPTIMAL PROJECTIONS
H. deWaard (ASM Micro Electronics Technology Center, Bilthoven, Netherlands) 1990 21 p
(Grant STW-DWI-77-1397)
(REPT-90-66; ISSN-0922-5641; ETN-91-98743) Copyright Avail: NTIS HC/MF A03

The design of a reduced order optimal dynamic compensator based on a high order model describing the heat transfer characteristics of a diffusion/LPCVD reactor, is discussed. In contrast to the standard design approach, optimal projection techniques are used to develop the optimal compensator. An algorithm is developed for solving the optimal projection equations, using a simple homotopy approach. Performance results of this compensator, in simulation and in a real application, are presented. ESA

N91-18691# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
H SUB INFINITY-CONTROL WITH STATE FEEDBACK: THE INFINITE DIMENSIONAL CASE
Bert vanKeulen, Marc Peters (Technische Univ., Eindhoven, Netherlands), and Ruth Curtain 1990 45 p Proposed for presentation at the MTNS 91, Kobe, Japan, 17-21 Jun. 1991
(W-9015; ETN-91-98763) Avail: NTIS HC/MF A03

The regular control H sub infinity control problem with state feedback for a class of infinite dimensional systems is formulated and solved. The result is a complete generalization of the finite dimensional one and, in particular, the solution is given in terms of the solvability of a certain Riccati equation. ESA

N91-18692*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MODES OF VISUAL RECOGNITION AND PERCEPTUALLY RELEVANT SKETCH-BASED CODING FOR IMAGES
Daniel J. Jobson Feb. 1991 24 p
(NASA-TM-104051; NAS 1.15:104051) Avail: NTIS HC/MF A03 CSCL 09B

A review of visual recognition studies is used to define two levels of information requirements. These two levels are related to two primary subdivisions of the spatial frequency domain of images and reflect two distinct different physical properties of arbitrary scenes. In particular, pathologies in recognition due to cerebral dysfunction point to a more complete split into two major types of processing: high spatial frequency edge based recognition vs. low spatial frequency lightness (and color) based recognition. The former is more central and general while the latter is more specific and is necessary for certain special tasks. The two modes of recognition can also be distinguished on the basis of physical scene properties: the highly localized edges associated with reflectance and sharp topographic transitions vs. smooth topographic undulation. The extreme case of heavily abstracted images is pursued to gain an understanding of the minimal information required to support both modes of recognition. Here the intention is to define the semantic core of transmission. This central core of processing can then be fleshed out with additional image information and coding and rendering techniques. Author

N91-18619*# Houston Univ., Clear Lake, TX. Dept. of Computer Science.
AN OVERVIEW OF THE ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS COMPONENT OF RICIS Abstract Only
Terry Feagin *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 09B

N91-18996*# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
FEASIBILITY STUDY OF ROBOTIC NEURAL CONTROLLERS
Mario E. Magana *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

N91-18997*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
NEURAL NETWORKS AS A CONTROL METHODOLOGY
Claire L. McCullough *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N91-18693 New South Wales Univ., Canberra (Australia).
FIRST KIND BOUNDARY INTEGRAL METHODS FOR TWO-DIMENSIONAL POTENTIAL PROBLEMS WITH SINGULARITIES Ph.D. Thesis, July 1989 Abstract Only
Yan Yi 24 May 1990 3 p
Avail: Issuing Activity

Consider the classical two-dimensional potential problem: Delta u = 0, in Omega subset R(exp 2) and u = f, on Gamma = delta Omega, where Omega is bounded or unbounded; the boundary Gamma can be a closed or open contour. First kind boundary integral methods represent the solution u(z) by a single layer potential. The unknown density is determined by solving the first kind boundary integral equation: f(x) = 1/pi integral(limit Gamma) log absolute value of (x-y) g(y)dy, x = Gamma. There are two advantages to this approach: one is the reduction of dimension; the other is the preservation of symmetry, coerciveness and variational form of the Laplace operator, in contrast to the second kind boundary integral method. Both of the properties result in an easier implementation in practical computation. This thesis gives a complete analysis of this approach. This includes the existence and uniqueness of the solution of the first kind equation, and an analysis of its numerical solution on many complicated

Gamma boundaries such as closed smooth contour, a polygon and an open contour. The tools used are classical potential theory, Fourier analysis, the Mellin transform, the energy integral, and spectral analysis. Author

N91-18694# Argonne National Lab., IL.
INCREASING THE GRANULARITY OF PARALLELISM AND REDUCING CONTENTION IN AUTOMATIC DIFFERENTIATION
Brad N. Karp and Christian H. Bischof Nov. 1990 13 p
(Contract W-31-109-eng-38)
(DE91-004747; ANL/MCS-TM-142) Avail: NTIS HC/MF A03

The automatic differentiation package ADOL-C of Griewank and Juedes, traces the computation of a function whose derivative is to be computed, and then subsequently propagates adjoint values long these traces paths according to the chain rule. While a sequential implementation of the reverse mode can utilize this trace by traversing it in reverse order, a parallel implementation must build the entire computational graph, as different processors will each simultaneously be working on different sections of the trace. In a sequential implementation, the linearized trace inherently obeys the dependencies of the function evaluation. In a parallel implementation, however, there must be a mechanism to determine whether a node's dependencies have been resolved yet, meaning that the node's adjoint value is computable. A node in the graph must represent a quantity of arithmetic operations large enough for a processor to do enough computation before it must communicate the result to another processor, but small enough for there to be enough nodes in the graph to allow many processors to work simultaneously. Sinks are bottlenecks for efficient parallel computation, as their many dependencies mean that many processors will contend for them simultaneously. These two factors are both familiar problems in parallel computation; the first is an issue of granularity, while the second is an issue of contention. As a first step toward achieving an efficient parallel implementation, we present a system for construction of a computational graph from ADOL-C's computational trace, as well as two transformations for this graph, hoisting and splitting, which improve its computational granularity and reduce contention, respectively. DOE

N91-18695# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
A GENERAL APPROACH TO GROWTH CURVES AND REPEATED MEASUREMENTS
I. G. Vlachonikolis Nov. 1990 14 p
(MATHS-REPT-A-136; ETN-91-98635) Avail: NTIS HC/MF A03

The polynomial growth curve model of Potthoff and Roy, defined by a matrix of observations from n individuals at q different times, is considered. A general model of covariance matrices was achieved for analysis of repeated measurements. Some special matrices obtained by imposing restrictions on the general model were examined. Parameter estimation by maximum likelihood was discussed. Uniform covariance structure, first or second order autoregressive structures and nonlinear autoregressive structures are given as examples. ESA

N91-18696# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A FIBONACCI-LIKE ITERATED NONLINEAR MAP OR ORDER FROM CHAOS IN THE REGION OF THE TINY TORNADOS
Peter R. J. Asveld May 1990 48 p
(MEMO-INF-90-10; ISSN-0923-1714; ETN-91-98649) Avail: NTIS HC/MF A03

A Fibonacci like variant of the well known iterated nonlinear map x sub (n+1) = lambda x sub n(1 - (x sub n)) is studied. The second order map contains two parameters of which one corresponds to lambda, whereas the other one, denoted by alpha, determines the relative influence of the two previous values. Fixing lambda to 3.9999 and varying the parameter alpha from 0 to 1 gives rise to some interesting behavior. Attention is focused on the corresponding pictures rather than any underlying theoretical issue. ESA

N91-18697# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ATTRIBUTE EVALUATION: NON-INCREMENTAL AND INCREMENTAL
Henk Alblas Jun. 1990 23 p
(MEMO-INF-90-28; ISSN-0923-1714; ETN-91-98655) Avail: NTIS HC/MF A03

The classical theory of attribute grammars is addressed. Non-incremental and incremental attribute evaluation strategies are surveyed. An overview of the main non-incremental evaluation methods, e.g., visits, sweeps, and passes is given. Incremental attribute evaluators, which reevaluate attributes after three transformations, are discussed. Incremental evaluators have applications in code optimization and language based editing. ESA

N91-18698# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ON THE EXPRESSIVENESS OF EQUATIONAL TYPE LOGIC
Vincenzo Manca, Antonino Salibra (Pisa Univ., Italy), and Giuseppe Scollo Jul. 1990 17 p Presented at IMA Conference on the Unified Computation Lab., Stirling, Scotland, 3-6 Jul. 1990 Submitted for publication
(MEMO-INF-90-39; ISSN-0923-1714; ETN-91-98661) Avail: NTIS HC/MF A03

Equational type logic is an extension of (conditional) equational logic, that widens 'equatorial reasoning' towards 'reasoning with equations and type assignments'. A comparison study with other extensions of equational logic such as (conditional) equational order sorted logic, logics of partial algebras, and Horn clausal logic, is presented. Translations of these logics into equational type logic are formulated, that endow these logics with sound and complete derivation systems. The study of equational type logic as a formal system for category theory is motivated and proposed as a topic for further investigation. ESA

N91-18699# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
AN ALGEBRA OF GENERALIZED FUNCTIONS ON A C SUP INFINITY MANIFOLD
J. W. deRoever and M. Damsma Jul. 1990 27 p Sponsored in part by Netherlands Organization for Scientific Research
(NWO Proj. 611-306-525)
(MATHS-MEMO-873; ISSN-0169-2690; ETN-91-98680) Avail: NTIS HC/MF A03

A sheaf of algebras of generalized functions containing the distributions on a C sup infinity manifold is constructed similarly to Colombeau's so called simplified algebra on the set of real numbers to the power of n. A relation between the restriction of its sections to an arbitrary submanifold with the analog for distributions is discussed. ESA

N91-18700# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON THE RATE OF CONVERGENCE OF PARTICULAR APPROXIMATE SOLUTIONS OF ELLIPTIC BOUNDARY AND EIGENVALUE PROBLEMS ON REGIONS WITH CORNERS
G. J. Still Aug. 1990 42 p
(MATHS-MEMO-879; ISSN-0169-2690; ETN-91-98685) Avail: NTIS HC/MF A03

Boundary and eigenvalue problems with elliptic operators L on a domain G a subset of a set of real numbers to the power of 2 are considered. By using Vekua's theory and approximation theory the approximation properties of some special classes of solutions u of Lu = 0 on G are studied. Investigations of the approximation properties of certain trial functions which have singularities at corners of G are of particular interest. Applied to defect minimization methods for solving boundary and eigenvalue problems this theory provides a class of trial functions which can be easily adapted to a given problem. In special situations the method produces approximations with extremely high accuracy by using only few trial functions. ESA

N91-18701# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MODULAR SUBSTRUCTURES IN PSEUDOMODULAR LATTICES
A. Dress, W. Hochstaettler (Cologne Univ., Germany, F.R.), and W. Kern Sep. 1990 14 p
(MATHS-MEMO-887; ISSN-0169-2690; ETN-91-98687) Avail: NTIS HC/MF A03

Pseudomodular lattices were used previously in order to investigate combinatorial properties of algebraic matroids and were further analyzed. Local conditions, characterizing modular sublattices of a pseudomodular lattice are presented. As an application, a previous result implying that Lovasz' min-max formula for matchings in projective geometries remains valid for pseudomodular lattices is derived, and a relation with Lindstroms construction of subgeometries which are isomorphic to projective geometries over skew fields is discussed. ESA

N91-18702# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
GEOMETRICALLY SMOOTH INTERPOLATION BY TRIANGULAR BERNSTEIN-BEZIER PATCHES WITH COALESCENT CONTROL POINTS
P. R. Pfluger (Amsterdam Univ., Netherlands) and M. Neamtu Oct. 1990 8 p Sponsored in part by Netherlands Foundation of Mathematics, and Netherlands Organization for the Advancement of Pure Research
(MATHS-MEMO-888; ISSN-0169-2690; ETN-91-98688) Avail: NTIS HC/MF A02

The problem of interpolating discrete data in the set of real numbers to the power of 3 is considered. The data consist of positional values and normal vectors. These data are interpolated by a geometrically smooth surface. This is accomplished by exploiting the so called degenerate triangular polynomial patches, which admit a completely local interpolation scheme. ESA

N91-18703# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SUBDIVIDING MULTIVARIATE POLYNOMIALS OVER SIMPLICES IN BERNSTEIN-BEZIER FORM WITHOUT DE CASTELJAU ALGORITHM
M. Neamtu Oct. 1990 7 p Sponsored by Netherlands Foundation of Mathematics, and Netherlands Organization for the Advancement of Pure Research
(MATHS-MEMO-889; ISSN-0169-2690; ETN-91-98689) Avail: NTIS HC/MF A02

Possible alternatives to the classical subdivision of Bernstein polynomials (i.e., based on utilizing the well known de Casteljau algorithm), are sketched. The schemes have asymptotically lower computational complexities and can be carried out such that the resulting control points take the precise values of the polynomial surface being subdivided. For one particular approach, the so called discrete Bernstein basis polynomials are introduced. ESA

N91-18704# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
NONLOCAL SYMMETRIES AND RECURSION OPERATOR OF THE LANDAU-LIFSHITZ EQUATION
Theo vanBemmelen and Paul H. M. Kersten Oct. 1990 42 p
(MATHS-MEMO-891; ISSN-0169-2690; ETN-91-98690) Avail: NTIS HC/MF A03

The Lie algebra of symmetries of the Landau-Lifshitz equation (LL) are considered. Infinitesimal (point, higher order and nonlocal) symmetries of the LL are calculated. The recursion operator is constructed from a nonlocal symmetry, reflecting the bi-Hamiltonian structure of the LL. The same recursion operator of the LL was derived by Barouch, Fokas and Papageorgiou who made use of the Lax pair. ESA

N91-18705# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
TRANSFORMATIONS OF NONLINEAR SYSTEMS INTO INPUT-OUTPUT PRIME FORM
R. Marino, W. Respondek (Polish Academy of Sciences, Warsaw.), and A. J. vanderSchaft Oct. 1990 11 p
(MATHS-MEMO-896; ISSN-0169-2690; ETN-91-98693) Avail: NTIS HC/MF A03

Based on a previous study, the problem of transforming a nonlinear system locally around its equilibrium into an input output prime system, using state space, feedback and also output space transformations, is discussed. Necessary and sufficient geometric conditions for the solvability are obtained. It turns out that from a computational point of view the output space transformation is the crucial step, which is performed by constructing rectifying coordinates for a tested sequence of distributions on the output manifold. ESA

N91-18706# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
THE LIE-BAECKLUND ALGEBRA FOR THE GENERALIZED HILBERT-CARTAN EQUATION
Paul H. M. Kersten Oct. 1990 15 p
(MATHS-MEMO-897; ISSN-0169-2690; ETN-91-98694) Avail: NTIS HC/MF A03

A previous study discussed symmetries and first and second order generalized symmetries for a given Hilbert-Cartan equation. A study which establishes the Lie-Baecklund symmetry algebra for the generalized Hilbert-Cartan equation u sub r = f(x,u,...,u sub (r minus 1),v,...,v sub k) is presented. It turns out to be completely algorithmic in nature. ESA

N91-18707# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
COMPUTATIONAL COMPLEXITY OF SOME MAXIMUM AVERAGE WEIGHT PROBLEMS WITH PRECEDENCE CONSTRAINTS
U. Faigle and W. Kern Oct. 1990 21 p
(MATHS-MEMO-899; ISSN-0169-2690; ETN-91-98695) Avail: NTIS HC/MF A03

The following problem is addressed: given a (partially) ordered set P with weight functions P onto (the set Z sub +) and integer k greater than 0, find an ideal I in P of size k and weight w(I) as large as possible. This problem is shown to be NP hard. Several variations of this problem, however, turn out to be solvable in polynomial time. Moreover, finding rooted subtrees of maximal average weight in rooted trees is easy. As an application, an efficient algorithm for a variant of the investment problem is obtained giving a positive answer to a question left open by a previous referenced study. ESA

N91-18708# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
MORE COMPUTATIONS ON GAUSS' LATTICE POINT PROBLEM
J. T. Tromp May 1990 13 p Submitted for publication
(CWI-CS-R9017; ETN-91-98701) Copyright Avail: NTIS HC/MF A03

A new method for counting the number of lattice points within increasingly larger circles is presented. It is used to study the difference between these numbers and the area within the circles. It is concluded that the vast amounts of memory present on computers nowadays can be exploited to significantly speed up counting of lattice points within circles (and other curves). Its application to Gauss' lattice point problem showed no deviation from previous referenced results. ESA

N91-18709# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
PROCESS ALGEBRA WITH A ZERO OBJECT
J. C. M. Baeten and J. A. Bergstra (Amsterdam Univ., Netherlands) Jun. 1990 17 p Revised Submitted for publication
(CWI-CS-R9028-REV; ETN-91-98711) Copyright Avail: NTIS HC/MF A03

A study introducing a constant 0 in process algebra is introduced and its properties are discussed. The object 0 acts as a zero for

both sum and multiplication in process algebra. The constant delta, representing deadlock or inaction, is only a left zero for multiplication. The object 0 is called predictable failure. ESA

N91-18710# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
A NEW STRATEGY FOR PROVING OMEGA-COMPLETENESS APPLIED TO PROCESS ALGEBRA
Jan Friso Groote Jul. 1990 24 p Sponsored in part by EEC
(CWI-CS-R9030; ETN-91-98713) Copyright Avail: NTIS
HC/MF A03

A new technique for proving omega-completeness based on proof transformations is presented. In the first place this technique is applied to axiom systems for finite, concrete and sequential processes. It turns out that the number of actions is important for these sets to be omega-complete. For the axiom systems for bisimulation and completed trace semantics one action suffices and for the trace axioms two actions are enough. The ready, failure, ready trace and failure trace axioms are only omega-complete if an infinite number of actions is available. In the second place, process algebra with parallelism is considered and several axiom sets (containing the axioms of standard concurrency) omega-complete are shown. ESA

N91-18711# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
A FULLY ABSTRACT MODEL FOR CONCURRENT NONDETERMINISTIC PROCESSES BASED ON POSETS WITH NON-ACTIONS
Ludmila Cherkasova (Academy of Sciences, USSR, Novosibirsk) Jul. 1990 45 p Sponsored in part by Netherlands Research and Education in Concurrent Systems Project
(CWI-CS-R9031; ETN-91-98714) Copyright Avail: NTIS
HC/MF A03

A study aiming to propose a new model based on the posets with non actions to describe the concurrent nondeterministic processes and investigate their properties is presented. The algebra SAFP sub 2 of structured finite processes with three main operations for specifying sequentiality, concurrency and nondeterminism is introduced. Denotational semantics based on posets with non actions is constructed for processes of SAFP sub 2. Full abstractness of denotational semantics wrt observational equivalence (approximately equal to plus) and proposed operational Petri net semantics are established. ESA

N91-18712# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
MATHEMATICAL MORPHOLOGY ON HOMOGENEOUS SPACES. PART 2: THE TRANSITIVE CASE
J. B. T. M. Roerdink Aug. 1990 26 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9006-PT-2; ETN-91-98717) Copyright Avail: NTIS
HC/MF A03

Mathematical morphology as originally developed by Matheron and Serra is a theory of image transformations invariant under the group of Euclidean translations, which is a commutative group. A generalization of mathematical morphology is developed by dropping the assumption that the invariance group is commutative. To this end, an arbitrary homogeneous space (the plane with the Euclidean translation group is one example, the sphere with the rotation group another) is defined i.e., a set Chi on which a transitive but necessarily commutative transformation group Gamma is defined. As the object space, the Boolean algebra Rho(Chi) of all subsets of this homogeneous space is taken. The case where the group action is simply transitive, or, equivalently, that the basic set Chi is itself a group was previously considered. The general case is treated by embedding the object space Rho(Chi) into Rho(Gamma), using the previous results which apply to Rho(gamma), and translating the results back to Rho(Chi). Generalizations of dilations, erosions, openings and closings are defined and several representation theorems are proved. Examples and possible applications are discussed. ESA

N91-18713# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
UNIFORM AIRY TYPE EXPANSIONS OF INTEGRALS
A. B. OldeDaalhuis and N. M. Temme Jul. 1990 21 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9011; ETN-91-98718) Copyright Avail: NTIS
HC/MF A03

New estimates for the remainder of uniform Airy type expansions of integrals containing a phase function with two coalescing saddle points are obtained. These expansions are obtained by the Bleistein method, in which both saddle points contribute to the expansion. The new estimates are valid as the asymptotic parameter tends to infinity, uniformly with respect to the parameter locating the saddle points as this parameter ranges over a connected unbounded set. Special attention is paid to the case of both the asymptotic parameter and the saddle point parameter tending to infinity. Two examples are worked out in detail, and the application of the method to other types of uniform expansions is explained. ESA

N91-18714# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
MATHEMATICAL MORPHOLOGY ON THE SPHERE
J. B. T. M. Roerdink Jul. 1990 13 p Presented at SPIE Conference on Visual Communications and Image Processing 1990, Lausanne, Switzerland, 2-4 Oct. 1990 Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9012; ETN-91-98719) Copyright Avail: NTIS
HC/MF A03

The extension of classical morphological definitions for Euclidean space to the sphere, where the rotation group replaces the Euclidean translation group is shown. Various motivations can be given for such a generalization, the most important one being that the Earth is spherical to a good approximation, which has to be taken into account when analyzing pictures taken by weather satellites. ESA

N91-18715# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
ASKEY-WILSON POLYNOMIALS AS ZONAL SPHERICAL FUNCTIONS ON THE SU(2) QUANTUM GROUP
Tom H. Koornwinder Aug. 1990 23 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9013; ETN-91-98720) Copyright Avail: NTIS
HC/MF A03

On the SU(2) quantum group the notion of (zonal) spherical element is generalized by considering left and right invariance in the infinitesimal sense with respect to twisted primitive elements of the SU(2) quantized universal enveloping algebra. The resulting spherical elements belonging to irreducible representations of quantum SU(2) turn out to be expressible as a two parameter family of Askey-Wilson polynomials. For a related basis change of the representation space a matrix of dual q-Krawtchouk polynomials is obtained. Big and little q-Jacobi polynomials are obtained as limits of Askey-Wilson polynomials. ESA

N91-18716# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
CONTINUOUS HAHN POLYNOMIALS OF DIFFERENTIAL OPERATOR ARGUMENT AND ANALYSIS ON RIEMANNIAN SYMMETRIC SPACES OF CONSTANT CURVATURE
Erich Badertscher and Tom H. Koornwinder Aug. 1990 24 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9015; ETN-91-98721) Copyright Avail: NTIS
HC/MF A03

The phenomenon associating spherical functions on Euclidean space and on spaces of constant positive and negative curvature is addressed. For the three types of simply connected Riemannian

spaces of constant curvature it is shown that the associated spherical functions can be obtained from the corresponding (zonal) spherical functions by application of a differential operator of the form p(i d/dt), where p belongs to a system of orthogonal polynomials: Gegenbauer, Hahn or continuous symmetric Hahn polynomials. A group theoretic explanation of this phenomenon is given and the properties of the polynomials p are related to the properties of the corresponding representation. The method is extended to the case of intertwining functions. ESA

N91-18717# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra, and Geometry.
MORPHOLOGICAL FILTERING AND ITERATION
H. J. A. M. Heijmans Aug. 1990 16 p Presented at SPIE Conference on Visual Communications and Image Processing 1990, Lausanne, Switzerland, 2-4 Oct. 1990 Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9016; ETN-91-98722) Copyright Avail: NTIS HC/MF A03

Basic concepts of mathematical morphology are reviewed. The construction of morphological filters, i.e., morphological operators which are increasing and idempotent, is an important problem in mathematical morphology. The construction of openings and closings and other morphological filters by iteration is described. It turns out that a sort of order continuity is required to guarantee that iteration leads to idempotence. An important class of operators which yield morphological filters after iteration are the so called pointwise monotone operators. The abstract theory is illustrated by a number of concrete examples. ESA

N91-18718# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
DISJOINT PATHS IN A PLANAR GRAPH: A GENERAL THEOREM
Guoli Ding, A. Schrijver, and P. D. Seymour (Bell Communications Research, Inc., Morristown, NJ.) Jun. 1990 8 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9012; ETN-91-98723) Copyright Avail: NTIS HC/MF A02

Let D = (V,A) be a directed planar graph, let (r sub 1, s sub 1),...,(r sub k, s sub k) be pairs of vertices on the boundary of the unbounded face, let A sub 1, ..., A sub k be subsets of A, and let H be a collection of unordered pairs from (1,...,k). Necessary and sufficient conditions are given for the existence of a directed r sub i - s sub i path P sub i (V, A sub i) (for i = 1,....,k), such that P sub i and P sub j are vertex disjoint whenever (i,j) is a member of H. ESA

N91-18719# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics and Systeem Theory.
DISJOINT CYCLES IN DIRECTED GRAPHS ON THE TORUS AND THE KLEIN BOTTLE
Guoli Ding, A. Schrijver, and P. D. Seymour (Bell Communications Research, Inc., Morristown, NJ.) Jun. 1990 8 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9013; ETN-91-98724) Copyright Avail: NTIS HC/MF A02

Necessary and sufficient conditions for a directed graph embedded on the torus or the Klein bottle to contain pairwise disjoint circuits are given. Each circuit is of a given orientation and homotopy, and in a given order. For the Klein bottle, the theorem is new. For the torus, the theorem was proved before by P.D. Seymour. A shorter proof of his results is presented. ESA

N91-18720# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
EDGE-DISJOINT CIRCUITS IN GRAPHS ON THE TORUS
A. Frank (Eoetvoes Lorand Univ., Budapest, Hungary) and A. Schrijver Jun. 1990 10 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9014; ETN-91-98725) Copyright Avail: NTIS HC/MF A02

Necessary and sufficient conditions for a given graph embedded on the torus are given. The graphs contain edge disjoint cycles of prescribed homotopies (under the assumption of a parity condition). Figures and graphs are presented as part of the proof of the theorem. ESA

N91-18721# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
A SIMPLER PROOF AND A GENERALIZATION OF THE ZERO-TREES THEOREM
A. Scrhijver and P. D. Seymour (Bell Communications Research, Inc., Morristown, NJ.) Jun. 1990 9 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9015; ETN-91-98726) Copyright Avail: NTIS HC/MF A02

Z. Furedi and D. J. Kleitman proved that if an integer weight is assigned to each edge of a complete graph on p + 1 vertices, then some spanning tree has total weight divisible by p. A simpler proof is obtained by generalizing the result to hypergraphs. The various steps of the proof are presented and each step of the proof is justified. ESA

N91-18722# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
DEFECT CORRECTION AND NONLINEAR MULTIGRID FOR STEADY EULER EQUATIONS
P. W. Hemker and Barry Koren Mar. 1990 19 p Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-NM-R9007; ETN-91-98732) Copyright Avail: NTIS HC/MF A03

A multigrid method developed for the steady Euler and Navier-Stokes equations is presented. The discretization method is based on cell centered finite volumes. The solution method, that does not use time stepping, is based on nonlinear multigrid iteration (FAS). The method gets many of its good properties by the use of a sequence of first order discretizations, based on a variant of Osher's approximate Riemann solver. Higher order accuracy is obtained by defect correction iteration. ESA

N91-18723# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
PARALLEL ODE SOLVERS
P. J. vanderHouwen and B. P. Sommeijer Apr. 1990 14 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-NM-R9008; ETN-91-98733) Copyright Avail: NTIS HC/MF A03

Two approaches in constructing parallel ordinary differential equations (ODE) methods are discussed. These equations are intended to be more efficient (in terms of wall clock time) than conventional methods. The methods are based on the extrapolation of basic ODE solvers and on iteration of implicit Runge-Kutta methods. The best sequential methods and parallel methods already available are listed in order to facilitate comparison with the parallel methods presented. ESA

N91-18724# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
SPURIOUS ENTROPY GENERATION IN A NON-SMOOTH GEOMETRY
Eric H. T. M. vanderMaarel and Barry Koren May 1990 20 p Sponsored by ESA and Netherlands Organization for the Advancement of Research
(CWI-NM-R9009; ETN-91-98734) Copyright Avail: NTIS HC/MF A03

Numerical entropy generation is studied in the case of steady, subsonic Euler flow along a kinked solid wall. For a standard

upwind finite volume discretization, the numerical entropy error appears to be zero order in mesh size. Two possible causes of the zero order entropy error are studied. Investigation is made of the local discretization error on a kinked grid. Although this error appears to be zero order in the neighborhood of the kink, it probably does not cause the zero order entropy error. Study is made of the existence of a singularity in the exact solution. Probably, the Euler flow solution is singular at the link in the wall. The form of this likely singularity is unknown. Therefore, the construction of a computational method which uses a priori knowledge about the singularity is not possible. It is shown by numerical experiment that the subsonic Euler flow along a kinked wall still can be computed with vanishing entropy errors, by using a continuously curved wall which converges to the kinked wall in the limit of zero mesh width. ESA

N91-18725# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ANALYSIS OF THE IMPLICIT EULER LOCAL UNIFORM GRID REFINEMENT METHOD
R. A. Trompert and J. G. Verwer Jul. 1990 46 p Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-NM-R9011; ETN-91-98736) Copyright Avail: NTIS HC/MF A03

Numerical solution of time dependent partial differential equations is discussed. Attention is focused on parabolic problems the solutions of which possess sharp moving transitions in space and time, such as steep moving fronts and emerging and disappearing layers. An adaptive grid method is analyzed that refines the space grid locally around sharp spatial transitions, so as to avoid discretization on a very fine grid over the entire physical domain. This method is based on the techniques called static regridding and local uniform grid refinement. Static regridding means that in the course of the time evolution the space grid is adapted at discrete times. Local uniform grid refinements means that the actual adaptation of the space grid takes place using nested locally uniformly refined grids. These uniform subgrids possess non physical boundaries and on each of these subgrids an integration is carried out. Stability and error analysis are carried out using the implicit Euler method for time integration. Maximum norm stability and convergence results are proved for a certain class of linear and nonlinear partial differential equations. The central issue hereby is a refinement condition with a refinement strategy that distributes spatial interpolation and discretization errors in such a way that accuracy obtained is comparable to the spatial accuracy on the finest grid if the grid would be used without any adaptation. The analysis is confirmed with a numerical illustration. ESA

N91-18726# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
UNCONDITIONAL CONVERGENCE OF SOME CRANK-NICHOLSON LOD METHODS FOR INITIAL-BOUNDARY VALUE PROBLEMS
W. H. Hunsdorfer Jul. 1990 26 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-NM-R9012; ETN-91-98737) Copyright Avail: NTIS HC/MF A03

Convergence properties are discussed for some Locally One Dimensional (LOD) splitting methods applied to linear parabolic initial boundary value problems. Unconditional convergence, where both the stepsize in time and the meshwidth in space tend to zero, independently of each other, is considered. The accuracy of some simple splitting methods is analyzed. The methods are used for the numerical solution of initial boundary value problems for Partial Differential Equations (PDEs) in two space dimensions. Discretization in space of such PDE problems leads to a large system of Ordinary Differential Equations (ODEs). ESA

N91-18727# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
SOME PROPERTIES OF CUBIC SYSTEMS
Robert E. Kooij 1990 27 p
(REPT-90-62; ISSN-0922-5641; ETN-91-98739) Copyright Avail: NTIS HC/MF A03

Some properties of special classes of cubic systems are discussed. For the cubic system with four straight line solutions of which exactly two are parallel, the nonexistence of limit cycles is proved, using Dulac's criterion. For the cubic system with two pairs of parallel straight line solutions, the existence of limit cycles by the Andronov-Hopf bifurcation and the nonexistence of limit cycles if a weak focus occurs are proven. The uniqueness of the limit cycle for this type of system is proved for some special cases, after transforming the cubic system to a Lienard system. A cubic system with a (+4, -3, +2) configuration of singularities is constructed, hereby answering a question raised by Ye Yanqian. ESA

N91-18728# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ALMOST NONINTERACTING CONTROL FOR LINEAR SYSTEMS WITH EXOGENEOUS INPUTS AND OUTPUTS
Jacob vanderWoude 1990 16 p
(REPT-90-63; ISSN-0922-5641; ETN-91-98740) Copyright Avail: NTIS HC/MF A03

A linear system that in addition to a control input and a measurement output has k exogenous inputs and k exogenous outputs is discussed. It is assumed that the system is controlled by means of a linear measurement feedback compensator. The resulting closed loop system has k exogenous input and k exogenous outputs. It is assumed that its transfer matrix is partitioned accordingly as a k by k matrix. If through the application of a suitable compensator the H sub infinity norm of the offdiagonal blocks of the closed loop system transfer matrix can be made arbitrarily small, the almost noninteracting control problem is considered sovable. Verifiable necessary and sufficient conditions for the solvability of the almost noninteracting control problem are presented. ESA

N91-18729# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
WEAKLY COMPACT SUBSETS OF SYMMETRIC OPERATOR SPACES
Peter G. Dodds, Theresa K. Dodds (Flinders Univ., Bedford Park, Australia), and Ben dePagter 1990 28 p
(REPT-90-68; ISSN-0922-5641; ETN-91-98745) Copyright Avail: NTIS HC/MF A03

Under natural conditions it is shown that the rearrangement invariant hull of a weakly compact subset of a properly symmetric Banach space of measurable operators affiliated with a semifinite von Neumann algebra is again relatively weakly compact. ESA

N91-18730# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON ASYMPTOTICS FOR A CLASS OF SEMI-LINEAR HYPERBOLIC EQUATIONS WITH SMALL FORCING TERMS
W. T. vanHorssen 1990 36 p
(REPT-90-69; ISSN-0922-5641; ETN-91-98746) Copyright Avail: NTIS HC/MF A03

An initial boundary value problem is considered for the semi linear hyperbolic equation u(sub tt) - u(sub xx) + p(exp 2)u + epsilon u(exp 3) = epsilon (A cos(omega(sub N) t)) + B sin(omega(sub N) t) sin(Nx) for t greater than 0 and x between 0 and pi, subject to the initial conditions u(x,0) = u(sub 0)(x) and u(sub t)(x,0) = u(sub 1)(x) for x between 0 and pi; the boundary conditions are u(0,t) = u(pi,t) = 0 for t greater than or equal to 0, where epsilon is a small parameter, p a nonzero constant independent of epsilon, and A, B, W sub N members of the set R, N members of the set Z+; u(sub 0) and u(sub 1) satisfy certain smoothness conditions. To construct asymptotic approximations a two timescales perturbation method is used. These types of problems may serve as simple models for the forced vibrations of a taut string embedded in a nonlinear medium. ESA

N91-18731# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
LAGUERRE POLYNOMIALS GENERALIZED TO A CERTAIN DISCRETE SOBOLEV INNER PRODUCT SPACE
H. G. Meijer 1990 28 p
(REPT-90-71; ISSN-0922-5641; ETN-91-98748) Copyright
Avail: NTIS HC/MF A03

The set of polynomials S(sub n)(sup M,N) which are orthogonal with respect to the discrete Sobolev inner product are considered. (f,g) = integral(limits 0 and infinity) w(x)f(x)g(x)dx + Mf(0)g(0) + Nf'(0)g'(0), where w is a weight function, M greater than or equal to 0, and N greater than or equal to 0. These polynomials are shown to be describable as a linear combination of classical polynomials which are orthogonal with respect to the weight functions w(x), x(exp 2)w(x) and x(exp 4)w(x). ESA

N91-18732# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
STRONG POSITIVITY IN C(OMEGA) FOR COOPERATIVE ELLIPTIC SYSTEMS
Guido Sweers 1990 10 p
(REPT-90-72; ISSN-0922-5641; ETN-91-98749) Copyright
Avail: NTIS HC/MF A02

A maximum for cooperative systems of elliptic equations is presented. Recently the problem has been revisited by several authors. Nagel uses semigroup theory for operator matrices and finds as an application a positivity result for the elliptic system. A direct proof is presented by using an extension of the Krein-Rutman Theorem. The underlying space is (C(omega))(exp k). In this approach it is sufficient to have operators with continuous coefficients and little regularity of the boundary of the domain. The existence of a unique first eigenfunction is shown. ESA

N91-18733# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON COMPOSANTS OF THE BUCKET HANDLE
Jan M. Aarts and Robbert J. Fokkink 1990 19 p
(REPT-90-74; ISSN-0922-5641; ETN-91-98751) Copyright
Avail: NTIS HC/MF A03

The permutations of composants induced by homeomorphisms on the bucket handle are studied. It appears that the only possible permutations are induced by iterates of the shift homeomorphism. It is shown that non-zero composants of the bucket handle can be mapped onto each other by continuous bijections. ESA

N91-18734# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
THE RATE OF CONVERGENCE OF THE GMRES METHOD
C. Vuik 1990 23 p
(REPT-90-77; ISSN-0922-5641; ETN-91-98754) Copyright
Avail: NTIS HC/MF A03

Th GMRES method, an iterative method for the solution of sparse linear systems with the nonsymmetric matrix, is discussed. Relationships between the GMRES method and a related iterative method, the FOM method, are described. It is shown that the Ritz values are the roots of the polynomial, which is used in the FOM method. Combination of these results gives insight into the convergence of the GMRES method and a relation with the convergence of the Ritz values. ESA

N91-18735# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON THE SINGULAR CYCLES OF A CLASS OF QUADRATIC SYSTEMS WITH A THIRD ORDER FINE FOCUS
Zhaojun Liang (Central China Normal Univ., Wuhan.) 1990 16 p Transl. into ENGLISH from Journal of Math. (China), v. 6, no. 4, 1986 p 411-417
(REPT-90-79; ISSN-0922-5641; ETN-91-98756) Copyright
Avail: NTIS HC/MF A03

The quadratic system dx/dt = -y + lx squared + 5axy, dy/dt = x + ax squared + 3lxy is studied. It is proved that when the origin is not a center, a singular cycle passing through a saddle and surrounding the origin does not exist nor does there exist a singular cycle with an infinite element surrounding the origin. Complete analysis of the system shows that there does not exist a limit cycle in the whole plane system. The nonexistence of singular cycles in the system and its phase portrait are studied. ESA

N91-18736# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
GENERATING TRIANGULATIONS OF 2-MANIFOLDS
Haijo Schipper 1990 17 p
(CS-9008; ETN-91-98758) Avail: NTIS HC/MF A03

It is shown how for a given triangulation T of a 2-manifold M a minimal triangulation T sub min of M and a sequence S of vertex splittings can be calculated such that performing S on T sub min gives T. The method will work in either O(n log n) time and linear space or in linear time if O (sq n) space is available, where n is the number of vertices of T. ESA

N91-18737# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
A NOTE ON HANKEL OPERATORS FOR INFINITE-DIMENSIONAL SYSTEMS
Bert vanKeulen 1990 16 p
(W-9002; ETN-91-98759) Avail: NTIS HC/MF A03

Mild assumptions under which a class of integral operators defines a Hankel operator are given. This has applications to infinite dimensional systems with strongly (but not exponentially) stable semigroup for which the known Hankel operator theory is not applicable. Hankel operators can be defined in both time and frequency domain, both for discrete and continuous time linear systems and under certain conditions they can all be related. Of particular importance is the relationship between the time and frequency domain Hankel operators. ESA

N91-18738# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
INTERPOLATION PROBLEMS, EXTENSIONS OF SYMMETRIC OPERATORS AND REPRODUCING KERNEL SPACES, 2
Daniel Alpay, Piet Bruinsma, Aad Dijksma, and Henk deSnoo 1990 57 p Submitted for publication
(W-9005; ETN-91-98760) Avail: NTIS HC/MF A04

Interpolation problems for pairs of matrix functions of the extended Nevanlinna class are discussed. Different approaches are used to make explicit the various links between them. An approach via the Krein-Langer theory of extensions of symmetric operators is considered. Dym's method is adapted to solve interpolation problems by means of the Branges theory of Hilbert spaces of analytic functions. How the two solution methods are connected is demonstrated. ESA

N91-18739# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
THEORETICAL DISTRIBUTION OF THE ELECTRONIC STRUCTURE OF DEFECTS ON METAL SURFACES Ph.D. Thesis [THEORETISCHE BESCHREIBUNG DER ELEKTRONISCHEN STRUKTUR VON STOERSTELLEN AN METALLOBERFLAECHEN]
Friedrich Christian Droste 1990 202 p In GERMAN
(ETN-91-98778) Avail: NTIS HC/MF A10

A new method based on the theory of scattering for the calculation of defect induced electronic structure on surfaces is developed. The method also allows to deal with volume defects, in the framework of equivalent approximations. A computer program which transforms the process numerically is produced. The scattering theory based method is described, and the necessary approximations are explained. The process is applied to the computation of defect and adsorbant systems. The model substrate of these calculations is the cubic surface centered transition metal palladium. Local defects of palladium surface, and of the crystal plane are considered. ESA

N91-18740*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
NUMERICAL RECOVERY OF MATERIAL PARAMETERS IN EULER-BERNOULLI BEAM MODELS Final Report
R. C. Smith, K. L. Bowers, and C. R. Vogel (Montana State Univ., Bozeman.) Feb. 1991 41 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187516; ICASE-91-14; NAS 1.26:187516) Avail: NTIS HC/MF A03 CSCL 12A

A fully Sinc-Galerkin method for recovering the spatially varying stiffness parameter in fourth-order time-dependence problems with fixed and cantilever boundary conditions is presented. The forward problems are discretized with a sinc basis in both the spatial and temporal domains. This yields an approximation solution which converges exponentially and is valid on the infinite time interval. When the forward methods are applied to parameter recovery problems, the resulting inverse problems are ill-posed. Tikhonov regularization is applied and the resulting minimization problems are solved via a quasi-Newton/trust region algorithm. The L-curve method is used to determine an appropriate value of the regularization parameter. Numerical results which highlight the method are given for problems with both fixed and cantilever boundary conditions. Author

N91-18741# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THE LINEAR TIME BRANCHING TIME SPECTRUM
Rob J. vanGlabbeek Jul. 1990 33 p Repr. from Comparative Concurrency Semantics and Refinement of Actions (Amsterdam, Netherlands), 1990 Sponsored by Technische Univ, Munich, Germany, F.R. and Netherlands Organization for the Advancement of Research
(CWI-CS-R9029; SFB-BER-342/90-A; ETN-91-98712) Copyright Avail: NTIS HC/MF A03

Various semantics in the linear time-branching time spectrum are presented in a uniform, model independent way. Restricted to the domain of finitely branching, concrete, sequential processes, only twelve of them turn out to be different, and most semantics found in the literature that can be defined uniformly in terms of action relations coincide with one of these twelve. Several testing scenarios, motivating these semantics, are presented, phrased in terms of button pushing experiments on generative and reactive machines. Ten of these semantics are applied to a simple language for finite, concrete, sequential, nondeterministic processes, and for each of them a complete axiomatization is provided. ESA

N91-18742# Los Alamos National Lab., NM.
NONLINEAR ADAPTIVE NETWORKS: A LITTLE THEORY, A FEW APPLICATIONS
R. D. Jones, S. Qian, C. W. Barnes, K. R. Bisset, G. M. Bruce, K. Lee, L. A. Lee, W. C. Mead, M. K. ORourke, and L. E. Thode et al 1990 33 p Presented at the Cognitive Modeling in System Control Conference, Santa Fe, 10-14 Jun. 1990
(Contract W-7405-eng-36)
(DE91-007469; LA-UR-91-273; CONF-9006311-1) Avail: NTIS HC/MF A03

We present the theory of nonlinear adaptive networks and discuss a few applications. In particular, we review the theory of feedforward backpropagation networks. We than present the theory of the Connectionist Normalized Linear Spline network in both its feedforward and iterated modes. Also, we briefly discuss the theory of stochastic cellular automata. We then discuss applications to chaotic time series tidal prediction in Venice Lagoon, sonar transient detection, control of nonlinear processes, balancing a double inverted pendulum and design advice for free electron lasers. DOE

N91-18318*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
ALGEBRAIC GEOMETRIC CODES
M. Shahshahani *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 103-108 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N91-18743# Los Alamos National Lab., NM.
APPLICATION OF NONLINEAR TIME SERIES MODELS TO DRIVEN SYSTEMS
Norman F. Hunter, Jr., Doyne Farmer, John Gibson, Martin Casdagli, and Stephen Eubank 1990 32 p Presented at the NATO Conference on Dynamic Systems, Santa Fe, NM, 20 Oct. 1990
(Contract W-7405-eng-36)
(DE91-005949; LA-UR-90-4364; CONF-9010284-1) Avail: NTIS HC/MF A03

An effort was made to model nonlinear systems using time series methods. The objectives were, first, to understand how the time series response of a nonlinear system unfolds as a function of the underlying state variables, second, to model the evolution of the state variables, and finally, to predict nonlinear system responses. The relationship between model parameters and system parameters will be addressed in the near future. Control of nonlinear systems based on experimentally derived parameters is also a planned topic of future research. DOE

N91-18744# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SIMULATION OF FAILURE PRONE TOKEN RINGS USING FAULT INJECTION SIMULATION
Aad P. A. vanMoorsel, Boudewijn R. Haverkort, and Ignas G. Niegemeers Aug. 1990 25 p
(MEMO-INF-90-44; ISSN-0923-1714; ETN-91-98663) Avail: NTIS HC/MF A03

A simulation technique, called Fault Injection Simulation (FIS) that, among others, can be used for deriving waiting time distributions in failure prone token systems is presented. Token systems, and more specially token rings, are used more and more for real time applications although the influence of faults such as token losses on the system performance are fairly unknown. Although these faults are generally rare, their influence on the waiting time distribution might be important for time critical applications. For these applications there is therefore special interest in the tail in the steady state waiting time distribution, since the probability mass in the tail is a measure for how probable deadlines are missed. The basic token ring operation is modeled by a polling model. A fault occurrence and recovery model is added to this. FIS combines results of simulations of fault free systems with results of simulations of systems with moderate fault occurrence probabilities, in order to obtain results for systems with very small fault occurrence probabilities. In this way the rare event problem is circumvented. A formal framework of the technique is given and FIS is applied to an FDDI (Fiber Distributed Data Interface) token ring network as an example of its use. ESA

N91-18745# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MULTIVARIATE DIVIDED DIFFERENCES. 1: BASIC PROPERTIES
M. Neamtu Aug. 1990 22 p Sponsored in part by Netherlands Foundation of Mathematics, and Netherlands Organization for the Advancement of Pure Research
(MATHS-MEMO-875-1; ISSN-0169-2690; ETN-91-98682) Avail: NTIS HC/MF A03

The notion of the univariate divided difference is generalized to the multivariate case. This generalization is based on a pointwise evaluation of a certain multivariate function. Several properties of the defined multivariate divided difference functional are derived

and a link with the multivariate simplex splines is established. This gives a new generalization of the so called truncated power function, which is different from one given previously. ESA

N91-18746# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
REACTIVE, GENERATIVE, AND STRATIFIED MODELS OF PROBABILISTIC PROCESSES
Rob J. vanGlabbeek, Scott A. Smolka, Bernhard Steffen, and Chris M. N. Tofts (Edinburgh Univ., Scotland) May 1990 15 p Presented at 5th Annual IEEE Symposium on Logic in Computer Science, Philadelphia, PA, 1990 Submitted for publication
(Grant NSF CCR-87-04309)
(CWI-CS-R9020; ETN-91-98704) Copyright Avail: NTIS HC/MF A03

Three models of probabilistic processes, namely, reactive, generative, and stratified are introduced. These models are investigated within the context of PCCS, dialect of Milners SCCS in which each summand of a process summation expression is guarded by a probability and the sum of these probabilities is 1. For each model, an operational semantics of PCCS and a motion of bisimulation equivalence which is proved to be a congruence are presented. It is shown that the models form a hierarchy: the reactive model by abstraction of the relative probabilities of different actions, and the generative model is derivable from the stratified model by abstraction of the purely probabilistic branching structure. ESA

N91-18747# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ASYMPTOTIC THEORY OF M-ESTIMATORS IN GENERAL STATISTICAL MODELS. PART 1: ON ASYMPTOTIC BEHAVIOUR OF ESTIMATORS UNDER MODEL DISTURBANCE
R. J. Chitashvili, N. L. Lazrieva, and T. A. Toronjadze (Academy of Sciences of the Georgian SSR, Tbilisi.) Jun. 1990 34 p Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9019-PT-1; ETN-91-98730) Copyright Avail: NTIS HC/MF A03

Asymptotics of parameter estimators in a general scheme of statistical models defined on a given probability space with filtration are discussed. The asymptotic behavior of estimators are studied and defined as solutions to certain equations (M-estimators). The representation of likelihood ratios in the form of exponential martingales is shown to be useful for application of martingale limit theorems. The conventional notations of martingale theory are used. Several examples of particular schemes of models are given. ESA

N91-18748# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ASYMPTOTIC THEORY OF M-ESTIMATORS IN GENERAL STATISTICAL MODELS. PART 2: ON ASYMPTOTIC BEHAVIOUR OF ESTIMATORS IN THE PRESENCE OF NUISANCE PARAMETERS
R. J. Chitashvili, N. L. Lazrieva, and T. A. Toronjadze (Academy of Sciences of the Georgian SSR, Tbilisi.) Jun. 1990 47 p Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9020-PT-2; ETN-91-98731) Copyright Avail: NTIS HC/MF A03

Regularity of M-estimators, one step approximation techniques, and stability of estimators with respect to model variations are discussed. Problems of parameter estimation in presence of a finite dimensional nuisance parameters are treated in detail, in particular, the asymptotic properties of so-called pseudo M-estimators, the method of skew projection, and the characterization of the limiting distributions of regular estimators. A scheme is proposed in which structural parameter estimators are constructed by the partial likelihood technique and the asymptotic variances are compared for estimators obtained by projection technique, partial likelihood technique and maximum likelihood estimation (under known nuisance parameters). Multidimensional parameter cases are considered. Detailed proofs of results are given. ESA

N91-18749# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
A VARIATIONAL FORMULA FOR BRANCHING RANDOM WALK IN RANDOM ENVIRONMENT
J.-B. Baillon, P. Clement (Heidelberg Univ., Germany, F.R.), A. Greven, and F. denHollander 1990 30 p Sponsored in part by DFG and Royal Netherlands Academy of Arts and Sciences, Amsterdam
(REPT-90-60; ISSN-0922-5641; ETN-91-98738) Copyright Avail: NTIS HC/MF A03

An infinite system of particles on the integers Z that drift to the right with a random delay and split or die along the way according to a random law depending on their position is discussed. The exponential growth rate of the particle density is computed in the long time limit in the form of a variational expression that can be solved explicitly. The result reveals two phase transitions associated with localization versus delocalization and survival versus extinction. In addition the system exhibits an intermittency effect. In Greven and den Hollander the more difficult situation is considered where the particles may drift both to left and right, but the analysis of the phase diagram is less complete. ESA

N91-18750# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
THEORETICAL CONSIDERATIONS ON ERROR MANAGEMENT
Jurgen Stigter 1990 52 p Sponsored by Netherlands National SPIN/FLAIR
(REPT-90-75; ISSN-0922-5641; ETN-91-98752) Copyright Avail: NTIS HC/MF A04

A definition of system reliability and failure of a system is presented. Erroneous states, errors and faults are discussed. Reliability requirements and types of faults are reviewed. Techniques for error management: error detection, damage assessment and confinement, error recovery, error diagnosis, fault treatment and continued reliable service, fault error documentation, and fault/error analysis (learning) and maintenance are described. An illustration of the theoretical considerations, an example of a system, and the problems in designing and operating it are given. Starting with a problem description, a system is designed and built (on paper). Error management considerations, and the difficulties of specifying a system are demonstrated. Problems of specification in relation to error management are discussed. ESA

N91-18751# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
THE ISLAMIC MEAN: A PECULIAR L-STATISTIC
H. G. Dehling, J. N. Kalma, C. Moes, and W. Schaafsma 22 Aug. 1990 14 p
(W-9013; ETN-91-98762) Avail: NTIS HC/MF A03

The limit behavior of the Islamic mean T sub n, a certain L-statistic with moving weights is studied. Under some regularity conditions, T sub n is a consistent and asymptotically normal estimator of the median. Nonstandard limit results are obtained in case the regularity conditions are violated. ESA

N91-18752# Lawrence Livermore National Lab., CA.
EXTENDING THE ALIAS MONTE CARLO SAMPLING METHOD TO GENERAL DISTRIBUTIONS
A. L. Edwards, J. A. Rathkopf, and R. K. Smidt (California Polytechnic State Univ., San Luis Obispo.) Jan. 1991 12 p Presented at the International Topical Meeting on Advances in Mathematics, Computations and Reactor Physics, Pittsburgh, 28 Apr. - 2 May. 1991
(Contract W-7405-eng-48)
(DE91-007619; UCRL-JC-104791; CONF-910414-16) Avail: NTIS HC/MF A03

The alias method is a Monte Carlo sampling technique that

offers significant advantages over more traditional methods. It equals the accuracy of table lookup and the speed of equal probable bins. The original formulation of this method, sampled from discrete distributions, was easily extended to histogram distributions. We have extended the method further to applications more germane to Monte Carlo particle transport codes: continuous distributions. This paper presents the alias method as originally derived and our extensions to simple continuous distributions represented by piecewise linear functions. We also present a method to interpolate accurately between distributions tabulated at points other than the point of interest. We present timing studies that demonstrate the method's increased efficiency over table lookup and show further speedup achieved through vectorization. DOE

N91-18315*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
MAXIMUM-ENTROPY PROBABILITY DISTRIBUTIONS UNDER Lp-NORM CONSTRAINTS
S. Dolinar *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 74-87 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 12A

N91-18621*# Houston Univ., Clear Lake, TX. Dept. of Mathematics.
AN OVERVIEW OF THE MATHEMATICAL AND STATISTICAL ANALYSIS COMPONENT OF RICIS Abstract Only
Cecil R. Hallum *In its* RICIS 1987 Symposium. Executive Summary 1987 1 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 05I

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N91-18753*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL FACTORING APPROACH FOR ANALYZING STOCHASTIC NETWORKS
Kelly J. Hayhurst and Douglas R. Shier (College of William and Mary, Williamsburg, VA.) Washington Mar. 1991 24 p
(NASA-TP-3069; L-16794; NAS 1.60:3069) Avail: NTIS HC/MF A03 CSCL 12B

The problem of finding the distribution of the shortest path length through a stochastic network is investigated. A general algorithm for determining the exact distribution of the shortest path length is developed based on the concept of conditional factoring, in which a directed, stochastic network is decomposed into an equivalent set of smaller, generally less complex subnetworks. Several network constructs are identified and exploited to reduce significantly the computational effort required to solve a network problem relative to complete enumeration. This algorithm can be applied to two important classes of stochastic path problems: determining the critical path distribution for acyclic networks and the exact two-terminal reliability for probabilistic networks. Computational experience with the algorithm was encouraging and allowed the exact solution of networks that have been previously analyzed only by approximation techniques. Author

N91-18754# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
USING DYNAMIC QUEUEING NETWORKS FOR PERFORMABILITY MODELLING
Boudewijn R. Haverkort and Ignas G. Niemegeers 10 May 1990 19 p Presented at European Simulation Multiconference, Nuernberg, Fed. Republic of Germany, 10-13 Jun. 1990 Submitted for publication
(MEMO-INF-90-25; ISSN-0923-1714; ETN-91-98652) Avail: NTIS HC/MF A03

A new approach in the modeling of computer systems that have a dynamic structure, such as fault tolerant gracefully degradable computer systems, is introduced. With these so called Dynamic Queueing Networks (DyQNs), product form queueing networks are used for modeling the performance aspects of the computer system under study, whereas a Generalized Stochastic Petri Net (GSPN) is used for modeling the fault tolerance aspects of the system under study. Combining the results of various performance analyses with the GSPN, a Markov reward model can be constructed that can be analyzed using well known techniques. Thus various performability measures can be obtained. With the proposed modeling technique, performability models known from the literature and more complicated performability aspects of distributed systems, such as recovery, routing and reconfiguration can be assessed. An example of the use of DyQNs is given and a DyQN tool currently being designed is discussed. ESA

N91-18755# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
DyQNtool: A PERFORMABILITY MODELLING TOOL BASED ON THE DYNAMIC QUEUING NETWORK CONCEPT
Boudewijn R. Haverkort and Paul VeldhuyzenvanZanten 30 May 1990 22 p
(MEMO-INF-90-26; ISSN-0923-1714; ETN-91-98653) Avail: NTIS HC/MF A03

A tool for performability modeling based on the dynamic queueing network concept, an approach in which queueing network analysis and generalized stochastic Petri nets are combined, is described. With this tool dynamic queueing network models can be easily constructed. The tool takes care of the automatic translation of the dynamic queueing network model to a Markov reward model. This Markov reward model is subsequently analyzed by well known techniques from the literature. The usage of the tool is illustrated by means of a large example. At the moment the DyQN tool exists in a first version intended to demonstrate its functionality and is not totally optimized for performance. Ways to achieve further performance gains are indicated. ESA

N91-18756# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
NON-ATOMIC EVENTS AND EVENT HIERARCHIES
Arend Resink Oct. 1990 22 p Sponsored in part by EEC (Proj. 890; Proj. PANGLOSS)
(MEMO-INF-90-63; ISSN-0923-1714; ETN-91-98676) Avail: NTIS HC/MF A03

Non atomic events differ from atomic events in the quality of their occurrence, which is point like for atomic events (either they have occurred or they have not), but interval like for non atomic events (there is a certain amount of time between their beginning and their end). The interval like quality of non atomic events is described. Organic event structures, which are sets of events with two distinct ordering relations representing precedence and influence, corresponding to complete and partial precedence of intervals are defined. By mapping events to intervals over a given ordered set of time points, these relations can be completely characterized which makes them mathematically tractable. The class of organic event structures that can be mapped to non overlapping intervals is shown to be equivalent to the class of atomic multi-event structures. Non atomic events are especially useful in settings where action refinement is investigated. In such investigations, one and the same behavior is viewed on different levels of abstraction, and a single event on one level may correspond to a complex structure on a lower level. In other words, there is a hierarchy of events. For each such behavior, there is proven to be an organic event structure which forgets the hierarchical structure and (in a sense) completely captures the ordering of the events on every desired level of abstraction. Atomic event structures are not powerful enough for this purpose. ESA

N91-18757# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
QUEUEING ANALYSIS OF A GENERALIZED SLOTTED-RING MODEL
B. vanArem (Ministry of Traffic and Transport, Arnheim, Netherlands) Oct. 1990 43 p
(MATHS-MEMO-900; ISSN-0169-2690; ETN-91-98696) Avail: NTIS HC/MF A03

A queueing system which generalizes several queueing models for slotted ring local area networks is studied. The model is described and some other possible applications are mentioned. Exact results are given but, taking the complexity of the model into account, the subsequent focus is on approximations for the expected queue lengths. The approximations are partly known approximations put into a general context. For two specific slotted ring models extensive comparisons of the approximations with simulation results are given. ESA

N91-18758# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ON THE ATTAINED WAITING TIME
J. W. Cohen Jun. 1990 7 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9016; ETN-91-98727) Copyright Avail: NTIS HC/MF A02

By using properties of up and downcrossing of the sample functions of the work load process and of attained waiting time process for a G/G/1 queueing model it is shown that both processes have the same stationary distribution, if such distributions do exist. Graphs of the downcrossings are presented to illustrate the proof. ESA

N91-18759# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
EFFICIENT VISIT ORDERS FOR POLLING SYSTEMS
O. J. Boxma, H. Levy, and J. A. Weststrate (Tilburg Univ., Netherlands) Jun. 1990 30 p Sponsored by Netherlands Organization for the Advancement of Research
(CWI-BS-R9017; ETN-91-98728) Copyright Avail: NTIS HC/MF A03

The issue of deriving efficient operational rules for polling systems with switchover periods is discussed. The following static optimization problem is studied. The server visit order (polling table) that mimimizes the mean total workload is determined. This problem is strongly related with, and in many applications coincides with, that of minimizing the overall mean customer delay in the system. Two heuristic approaches to the polling table problem are presented, both using the exact solution of a related problem. The first approach is based on exact optimality results for a random polling system with the same traffic characteristics. The second approach uses a polling table model, in the analysis of which some of the restrictions are relaxed. Numerical experiments show that both approaches yield excellent results. ESA

N91-18760# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
MAX-ALGEBRA MODELLING AND ANALYSIS OF TIME-TABLE DEPENDENT TRANSPORTATION NETWORKS
J. G. Braker 1990 53 p
(REPT-90-65; ISSN-0922-5641; ETN-91-98742) Copyright Avail: NTIS HC/MF A04

The max algebra approach of discrete event dynamic systems is applied to the simulation and analysis of a railway system operating under a time table. The general theory is developed and a specific example is analyzed. ESA

N91-18761# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
HOW TO REASON WITH UNCERTAIN KNOWLEDGE, PART 2
Nico Roos 1990 19 p
(REPT-90-70-PT-2; ISSN-0922-5641; ETN-91-98747) Copyright Avail: NTIS HC/MF A03

Two kinds of uncertainty, general and specific uncertainty, are distinguished. General uncertainty denotes an uncertainty about which objects of a class belong to a relation. Sentences in which it occurs can be viewed as describing incomplete knowledge. An example of such a sentence is: Most humans have brown eyes. Specific uncertainty denotes an uncertainty about whether a relation holds for some specific object. For example: John probably has brown eyes. Sentences containing this kind of uncertainty are conclusions based on the state of knowledge of the reasoning agent. These conclusions can be divided into two subclasses, expectations and explanations. Here, an explanation denotes a possible cause for anomalies observed. The uncertainty of both kinds of conclusion depends on the state of knowledge of the reasoning agent. To guarantee the correctness of these conclusions, all relevant information has to be taken into account. To be able to do this the reasoning process is based on the construction of a partial model of the world we are reasoning about. This approach guarantees the tractability of the reasoning process. Based on the explanations, an efficient reasoning process is defined. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N91-18762# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
NON-COMMUTATIVE KOETHE DUALITY
Peter G. Dodds, Theresa K. Dodds (Flinders Univ., Bedford Park, Australia), and Ben dePagter 1990 64 p
(REPT-90-67; ISSN-0922-5641; ETN-91-98744) Copyright Avail: NTIS HC/MF A04

Using techniques drawn from the classical theory of rearrangement invariant Banach function spaces a duality theory in the sense of Koethe for symmetric Banach spaces of measurable operators affiliated with a semifinite von Neumann algebra equipped with a distinguished trace is developed. The Koethe dual of a given Banach space of measurable operators in terms of normality is identified. ESA

N91-18763# Joint Inst. for Nuclear Research, Dubna (USSR).
MODELLING OF MULTIDIMENSIONAL QUANTUM SYSTEMS BY THE NUMERICAL FUNCTIONAL INTEGRATION
Yu. Yu. Lobanov, E. P. Zhidkov, and R. R. Shahbagian (Academy of Sciences of the Armenian SSR, Erivan.) 1990 10 p Presented at the International IMACS Conference on Mathematical Modelling and Applied Mathematics, Vilnius, USSR, 18-23 Jun. 1990
(DE91-007051; JINR-E-11-90-393; CONF-900685-1) Avail: NTIS HC/MF A02

The employment of the numerical functional integration for the description of multidimensional systems in quantum and statistical physics is considered. For the multiple functional integrals, with respect to Gaussian measures in the full separable metric spaces, the new approximation formulas exact on a class of polynomial functionals of a given summary degree are constructed. The use of the formulas is demonstrated on example of computation of the Green function and the ground state energy in multidimensional Calogero model. The comparison of numerical results with the data obtained by the other authors which used the Monte Carlo method combined with iterative algorithms indicates that our formulas provide the higher efficiency of computations. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N91-18764# Brookhaven National Lab., Upton, NY.
THE COMPLEMENTARITY OF X RAYS AND NEUTRONS
John D. Axe 1990 8 p Presented at the 6th International School on Neutron Physics, Alushta, USSR, 8-18 Oct. 1990
(Contract DE-AC02-76CH-00016)
(DE91-005544; BNL-45492; CONF-9010278-1) Avail: NTIS HC/MF A02

Nature is subtle and grudgingly reveals her secrets. In such an uneven contest scientists need to exploit every possible advantage. Just as high energy and nuclear physicists use hadrons, leptons and photons as scattering probes, so the modern condensed matter scientists relies upon NMR, ESR, (mu)SR, infrared, optical and UV spectroscopy as well as classical transport and thermal measurements, to understand material properties. For structural studies electron and x-ray diffraction are commonly used. Traditionally, neutrons, because of the expense and the potential for greater environmental impact associated with their production, are reserved for studies where their unique properties mandate their use. The emergence throughout the world of major user facilities for both synchrotron x-rays and neutrons has recently underlined the degree to which x-ray and neutron scattering studies complement one another. Let us quickly review some of the advantages of neutrons. Neutrons are more penetrating, more precise (to the extent that they scatter from the nucleus rather than the extended electron cloud), more uniform in scattering power, more 'magnetic' and more massive (and thus less energetic) than x-rays of comparable wavelength. Indeed, if expense and ease of access were not a factor, neutrons would very often be the probe of choice. This report discusses some of these properties of neutrons and how they complement x-ray diffraction in condensed matter studies. DOE

N91-18765# National Inst. for Fusion Science, Nagoya (Japan).
APPLICATION OF FIXED POINT THEORY TO CHAOTIC ATTRACTORS OF FORCED OSCILLATORS
H. Bruce Stewart (Brookhaven National Lab., Upton, NY.) Nov. 1990 26 p
(NIFS-62; ISSN-0915-633X) Avail: NTIS HC/MF A03

A review of the structure of chaotic attractors of periodically forced second-order nonlinear oscillators suggests that the theory of fixed points of transformations gives information about the fundamental topological structure of attractors. First, a simple extension of the Levinson index formula is proven. Then, numerical evidence is used to formulate plausible conjectures about absorbing regions containing the chaotic attractor on the one hand, and a topological invariant of an absorbing region on the other hand. Author

N91-18766# Stichting voor Fundamenteel Onderzoek der Materie, Utrecht (Netherlands).
[ACTIVITIES REPORT OF THE FOUNDATION FOR FUNDAMENTAL RESEARCH ON MATTER] Annual Report, 1988 [JAARBOEK 1988, STICHTING VOOR FUNDAMENTEEL ONDERZOEK DER MATERIE]
Sep. 1989 104 p In DUTCH
(ETN-91-98765) Avail: NTIS HC/MF A06

The research activities of the following research institutes and research groups are summarized: the National Institute for Nuclear Physics and High Energy Physics; the Nuclear Physics Accelerator Institute; the Institute for Plasma Physics; the Institute for Atomic and Molecular Physics; the Center for submicron Technology; The Working Group for Theoretical High Energy Physics; the Working Group for Nuclear Physics; the Working Group for Atomic Physics and quantum Electronics; the Working Group for Statistical Physics; the Working Group for Materials; the Working Group for Semiconductors; the Special Commission for Technical Physics; the Association Mathematical Physics; the Advisory Commission Flow and Heat; and the Advisory Commission Physical Information Theory. ESA

N91-18767# Stichting voor Fundamenteel Onderzoek der Materie, Utrecht (Netherlands).
[ACTIVITIES REPORT OF THE FOUNDATION FOR FUNDAMENTAL RESEARCH ON MATTER] Annual Report, 1989 [JAARBOEK 1989, STICHTING VOOR FUNDAMENTEEL ONDERZOEK DER MATERIE]
Jul. 1990 116 p In DUTCH
(ETN-91-98766) Avail: NTIS HC/MF A06

The research activities of the following institutes and research groups are summarized: the National Institute for Nuclear Physics and High Energy Physics; The Nuclear Physics Accelerator Institute; the Institute for Plasma Physics; the Institute for Atomic and Molecular Physics; the Research Group on Submicron Physics and Technology; the Working Group for Theoretical High Energy Physics; the Working Group for Nuclear Physics; the Working Group for Atomic Physics and Quantum Electronics; the Working Group for Statistical Physics; the Working Group for Materials; the Working Group for Solid State Physics; the Working Group for Semiconductors; the Special Commission for Technical Physics; the Association Mathematical Physics; the Simulation Group on Flow and Heat; and the Simulation Group on Physical Information Theory. ESA

N91-18768# Technische Physische Dienst TNO-TH, Delft (Netherlands).
[ACTIVITIES REPORT OF THE INSTITUTE OF APPLIED PHYSICS TNO-TU DELFT] Annual Report, 1989 [TECHNISCHE PHYSISCHE DIENTST TNO-TU DELFT, JAARVERSLAG 1989]
1990 40 p In DUTCH
(ETN-91-98769) Avail: NTIS HC/MF A03

In the field of noise, marine acoustics, anti noise and low noise constructions were studied. In the field of heat, computer simulations of air flow were performed, systems analyses were made, air conditioning installations were studied, and solar energy applications were investigated. Ceramic materials were developed. Optical instrumentation as well as sensors and measuring systems for different applications were developed. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N91-18769# Lawrence Livermore National Lab., CA.
LOCALIZED WAVE TRANSPORT OF PULSED BEAM ENERGY
D. Kent Lewis, Richard W. Ziolkowski, and Bill D. Cook (Houston Univ., TX.) Jun. 1990 6 p Presented at the Symposium on Physical Acoustics: Fundamental and Applied, Kortrijk, Belgium, 19-22 Jun. 1990
(Contract W-7405-eng-48)
(DE91-005066; UCRL-JC-103326; CONF-9006300-1) Avail: NTIS HC/MF A02

This paper describes the theory and experiments used to measure a new type of finite beam pulse, the localized wave pulse. The LW pulse is a linear superposition of Gaussian-like basis functions which are constructed from the focus wave modes of Brittingham by means of the modified power spectrum. Experiments to data have made use of three techniques. Synthetic array experiments using acousto-optic measurements were first undertaken to see if the localized wave pulses could be launched by normal acoustic devices. Next, synthetic array two transducer measurements were done to see if the beam generated would outperform a conventional continuous wave or pulsed array with both Gaussian shading and no shading. Finally, real array experiments were performed to see if the beam could be launched with actual acoustic arrays and still perform as well as in the synthetic array measurements. In all cases, the LW pulse has outperformed comparable beams by a wide margin. The theory

will be outlined and the methods of measurement sketched. Finally, comparison of beams produced by driving the array with different inputs will be presented. DOE

N91-18770# Johns Hopkins Univ., Baltimore, MD.
LASER ULTRASONICS: CURRENT RESEARCH NEEDS
James W. Wagner 26 Sep. 1990 16 p Prepared in cooperation with Lawrence Livermore National Lab., CA
(Contract W-7405-eng-48)
(DE91-005421; UCRL-CR-105763) Avail: NTIS HC/MF A03

Laser-ultrasonics refers to a range of technologies involving the use of laser electrooptical systems both to generate and to detect ultrasonic signals in and on materials and structures. Such systems have been developed to permit classical ultrasonic measurements for materials characterization and defect identification and measurement. From the point of view of one concerned with practical applications of ultrasonic inspection and measurement methods, laser-ultrasonic systems offer the flexibility which, in principle, should permit remote ultrasonic measurements to be performed on objects at elevated temperatures or in hostile environments. Laser-ultrasonic systems can be designed and constructed with extremely wide and flat detection bandwidth so that ultrasonic vibrational displacements can be recorded with high fidelity. In addition, there is no mechanical loading of the surface to damp, absorb, or otherwise distort the propagating acoustic energy. This feature has been used to great advantage in performing ultrasonic measurements in thin plates and films. In spite of the great advantages offered by laser-ultrasonics, there are severe limitations which restrict its application. In fact, based upon the performance of current state-of-the-art laser-ultrasonic systems, it is almost always more advantageous to use conventional ultrasonic transduction methods, if possible for a given application, than it is to apply laser-ultrasonics. In short, the main reason leading to this conclusion is the poor system detection sensitivity of laser-ultrasonic systems compared with piezoelectric transducer systems. The ramifications of this limited sensitivity are many. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N91-18771# Department of the Navy, Washington, DC.
PLANAR IMAGING BY NUCLEAR MAGNETIC RESONANCE
Patent Application
Joel B. Miller, inventor (to Navy) and Allen Garroway, inventor (to Navy) 29 Aug. 1990 26 p
(AD-D014711; US-PATENT-APPL-SN-574182;
NAVY-CASE-71641) Avail: NTIS HC/MF A03 CSCL 20/5

The present invention relates generally to the imaging of materials, and more specifically to the imaging of materials by nuclear magnetic resonance. Materials are imaged by exciting only one volume of interest (VOI) at a time while leaving the other undisturbed. By switching the irradiation frequency and probe tuning to the next VOI, the time delay between acquisitions of different VOI's may be essentially eliminated. The present invention may be implemented using a new coil design which is also useful for microscale planar imaging. GRA

N91-18772*# Eloret Corp., Palo Alto, CA.
POLYATOMIC MOLECULAR DIRAC-HARTREE-FOCK CALCULATIONS WITH GAUSSIAN BASIS SETS
Kenneth G. Dyall, Knut Faegri, Jr., and Peter R. Taylor (Oslo Univ., Norway) [1990] 24 p Sponsored by Norwegian Research Council for Science and the Humanities
(Contracts NCC2-552; NCC2-371)
(NASA-CR-187854; NAS 1.26:187854) Avail: NTIS HC/MF A03 CSCL 20H

Numerical methods have been used successfully in atomic Dirac-Hartree-Fock (DHF) calculations for many years. Some DHF calculations using numerical methods have been done on diatomic molecules, but while these serve a useful purpose for calibration, the computational effort in extending this approach to polyatomic molecules is prohibitive. An alternative more in line with traditional quantum chemistry is to use an analytical basis set expansion of the wave function. This approach fell into disrepute in the early 1980's due to problems with variational collapse and intruder states, but has recently been put on firm theoretical foundations. In particular, the problems of variational collapse are well understood, and prescriptions for avoiding the most serious failures have been developed. Consequently, it is now possible to develop reliable molecular programs using basis set methods. This paper describes such a program and reports results of test calculations to demonstrate the convergence and stability of the method.
Author

N91-18773# Virginia Univ., Charlottesville.
ELECTROMAGNETIC INTERACTIONS WITH NUCLEI AND NUCLEONS Progress Report, Nov. 1989 - Nov. 1990
Stephen T. Thornton and Richard M. Sealock 10 Nov. 1990 46 p
(Contract DE-FG05-89ER-40501)
(DE91-005096; DOE/ER-40501/2) Avail: NTIS HC/MF A03

The following topics are discussed: general LEGS work; photodisintegration of the deuteron; progress towards other experiments; LEGS instrumentation; major LEGS software projects; NaI detector system; nucleon detector system; waveshifting fibers; EGN prototype detector for CEBAF; photon beam facility at CEBAF; delta electroproduction in nuclei; quasielastic scattering and excitation of the Delta by He-4(e,e'); and quasielastic scattering at high Q(sup 2). DOE

N91-18774# Boston Univ., MA. Dept. of Physics.
RESEARCH ACCOMPLISHMENTS AND FUTURE GOALS IN PARTICLE PHYSICS
30 Nov. 1990 164 p
(Contract DE-AC02-89ER-40509)
(DE91-005350; DOE/ER-40509/2) Avail: NTIS HC/MF A08

This document presents our proposal to continue the activities of Boston University researchers in high energy physics research. We have a broad program of participation in both non-accelerator and accelerator-based efforts. High energy research at Boston University has a special focus on the physics program of the Superconducting Super Collider (SSC). We are active in research and development for detector subsystems, in the design of experiments, and in study of the phenomenology of the very high energy interactions to be observed at the SSC. The particular areas discussed in this paper are: colliding beams physics; accelerator design physics; MACRO project; proton decay project; theoretical particle physics; muon G-2 project; fast liquid scintillators; SSCINTCAL project; TRD project; massively parallel processing for the SSC; and physics analysis and vertex detector upgrade at L3. DOE

N91-18775# Pacific Northwest Lab., Richland, WA.
ELECTRON EMISSION IN H-0-ATOM COLLISIONS: A COINCIDENCE STUDY OF THE ANGULAR DEPENDENCE
O. Heil, R. Maier, M. Kuzel, K.-O. Groeneveld (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany, F.R.), and R. D. DuBois Oct. 1990 12 p Presented at the 11th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 5-8 Nov. 1990 Sponsored in part by Bundesministerium fuer Forschung und Technologie and Fulbright Commission
(Contract DE-AC06-76RL-01830)
(DE91-005555; PNL-SA-18739; CONF-901116-33) Avail: NTIS HC/MF A03

Differential electron emission occurring as the result of fast hydrogen atom impact on helium and argon targets has been studied using standard non-coincidence and emitted electron-ionized projectile coincidence techniques. Impact energies were 0.5 and 1 MeV; electron emission was measured between approximately 20 and 2000 eV for selected laboratory emission angles ranging from 0 degree to 180 degrees. These data

demonstrate the importance of simultaneous target-projectile ionization as was previously observed for energetic He(+) impact. The experimental data for the helium target, when compared to PWBA calculations using hydrogenic wave functions, indicate good agreement with theory for projectile ionization and, indirectly, reasonably good agreement for target ionization. Simultaneous target-projectile ionization events were not included in the model. The argon data are compared with more sophisticated calculations for electron loss. These comparisons indicate the importance of second order effects at large emission angles. DOE

N91-18776# Pacific Northwest Lab., Richland, WA.
CORRELATIONS BETWEEN CHARGED PARTICLES EMITTED IN ION-MOLECULE COLLISIONS
R. D. DuBois, R. Herrmann, R. Doerner, J. Euler, K. Ullmann, and J. Feng (Lanzhou Univ., China) Sep. 1990 3 p Presented at the 5th International Conference on the Physics of Highly Charged Ions, Giessen, Federal Republic of Germany, 10-14 Sep. 1990 Sponsored in part by Bundesministerium fuer Forschung und Technologie and Fulbright Commission
(Contract DE-AC06-76RL-01830)
(DE91-005557; PNL-SA-18538; CONF-900923-7) Avail: NTIS HC/MF A01

A new experimental apparatus for studying correlations between charged particles emitted in ion-atom collisions is described. The apparatus consists of two channelplate detectors, each equipped with position sensitive anodes. Time correlated events in both detectors provide information about correlated charged particle emission. Initial test studies of dissociative double ionization for H2 and N2 targets are reported here. DOE

N91-18777# Carnegie-Mellon Univ., Pittsburgh, PA. Medium Energy Physics Group.
EXPERIMENTAL MEDIUM ENERGY PHYSICS Annual Progress Report, Jun. 1989 - May 1990
P. D. Barnes 1990 109 p
(Contract DE-FG02-87ER-40315)
(DE91-005779; DOE/ER-40315/178) Avail: NTIS HC/MF A06

The following topics are discussed: search for the H-dibaryon at the AGS; weak interaction studies with hypernuclear decays at the AGS; search for the (xi)(2230) at LEAR; relativistic proton nucleus and heavy ion nucleus collisions at the SPS; hyperon-antihyperon production studies at LEAR; photoproduction of strange CEBAF; and experiment design development. DOE

N91-18778# Sandia National Labs., Albuquerque, NM. Test Planning and Diagnostics Div.
SCATTERING OF PHOTONS FROM ATOMIC ELECTRONS
R. H. Pratt, B. Zhou, P. M. Bergstrom, Jr., Lynn Kissel, K. Pisk, and T. Suric (Institut Rudjer Boskovic, Zagreb, Yugoslavia) 1990 10 p Presented at the International Workshop on Radiative Properties of Hot Dense Matter, Sarasota, FL, 22-26 Oct. 1990 Sponsored in part by Pittsburgh Supercomputing Center, PA
(Contract DE-AC04-76DP-00789; NSF PHY-90-05763; NSF INT-87-04953)
(DE91-006268; SAND-90-2539C; CONF-9010298-1) Avail: NTIS HC/MF A02

Validity of simpler approaches for elastic and inelastic photon scattering by atoms and ions is assessed by comparison with second-order S-matrix predictions. A simple scheme for elastic scattering based on angle-independent anomalous scattering factors has been found to give useful predictions near and below photoeffect thresholds. In inelastic scattering, major deviations are found from A(sup 2)-based calculations. Extension of free-atom and free-ion cross sections to the dense plasma regime is discussed. DOE

N91-18779# Oak Ridge National Lab., TN. Center for Computationally Intensive Physics.
SPIN EFFECTS IN TWO-PHOTON PAIR PRODUCTION
C. J. Albert, D. J. Ernst (Texas A&M Univ., College Station.), C. Bottcher, and M. R. Strayer 1990 12 p Presented at the 2nd International Conference on Medium- and High-Energy Nuclear Physics, Taipei, Taiwan, 8-18 May 1990
(Contract DE-AC05-84OR-21400)
(DE91-006271; CONF-9005233-11) Avail: NTIS HC/MF A03

The two-photon mechanism for lepton pair production is investigated. It is found that for pairs produced in certain kinematical regions the process is dominated by magnetic, spin-flip currents. Anomalous e+e- pairs observed in 17 GeV/c pion-proton collisions are found to be predominantly produced by this spin-flip mechanism. A comparison between He-4 + He-4 collisions and He-3 + He-4 collisions is proposed as an experimental way of distinguishing between the electric, non spin-flip mechanism and the magnetic, spin-flip mechanism. DOE

N91-18780# Argonne National Lab., IL.
OVERVIEW OF RF SYSTEMS FOR THE ADVANCED PHOTON SOURCE
James F. Bridges 1990 68 p Presented at the RF Expo East 1990, Orlando, FL, 13-15 Nov. 1990
(Contract W-31-109-eng-38)
(DE91-006395; CONF-9011170-1) Avail: NTIS HC/MF A04

The advanced photon source (APS) is being built by Argonne National Laboratory (ANL) near Chicago. The APS is a 7-GeV positron storage ring from which x ray beams of energies from a few keV to hundreds of keV are emitted as the positrons pass through ring bending magnets and also through special magnets called wigglers and undulators. The present schedule is to be operational in 1995. The energy emitted from the positron beam as x rays is replaced through a radio-frequency accelerating system operating at 352 MHz at a maximum power level of 3 MW. The RF system will be described as well as several lower-power systems at frequencies of 0.8 MHz, 117 MHz, and 2.8 GHz. The associated control electronics (phase shifters amplitude control, automatic tuning control, etc.) as well as the computer control architecture will also be described. DOE

N91-18781# Pennsylvania State Univ., State College. Dept. of Physics.
THEORETICAL STUDIES IN ELEMENTARY PARTICLE PHYSICS
John Collins 1990 6 p
(Contract DE-FG02-90ER-40577)
(DE91-006795; DOE/ER-40577/1) Avail: NTIS HC/MF A02

This report discusses theoretical research in elementary particles in the following areas: photoproduction; W-top backgrounds to Higgs production; charged Higgs production; measuring strong coupling; polarization and Z'; and polarization of top quark. DOE

N91-18782# New Hampshire Univ., Durham. Dept. of Physics.
ELECTROMAGNETIC STUDIES OF NUCLEAR STRUCTURE AND REACTIONS Progress Report
F. W. Hersman, J. F. Dawson, J. H. Heisenberg, and J. R. Calarco Jun. 1990 96 p
(Contract DE-FG02-88ER-40410)
(DE91-006820; DOE/ER-40410/T1) Avail: NTIS HC/MF A05

This report contains papers on the following topics: giant resonance studies; deep inelastic scattering studies; high resolution nuclear structure work; and relativistic RPA; and field theory in the Schroedinger Representation. DOE

N91-18783# Clark-Atlanta Univ., GA.
THEORETICAL INVESTIGATION OF ELECTRON-POSITIVE ION/ATOM INTERACTIONS Progress Report, 1 Jul. 1987 - 1 Mar. 1990
Alfred Z. Msezane 1990 12 p
(Contract DE-FG05-84ER-13266)
(DE91-006844; DOE/ER-13266/7) Avail: NTIS HC/MF A03

This report discusses the following topics: electron-impact excitation of Ca II; collisional excitation of oxygen-like Kr by electron impact; GOS for dipole-forbidden transitions in Cu I, Zn II and Mg II; correlation effects in Cd II; electron scattering from atomic Na; collisional excitation of some core-excited Na I quartet states; electron excitation of neonlike Na and argonlike K; inner-shell

excitation of Cr(sup 5+) by electron-impact; electron impact cross sections for boronlike N; photoionization of ground Na; and photoionization of ground state K. DOE

N91-18784# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SPECTROSCOPIC AND DYNAMICAL STUDIES OF HIGHLY ENERGIZED SMALL POLYATOMIC MOLECULES Technical Progress Report, 1 Feb. - 31 Aug. 1990
Robert W. Field and Robert J. Silbey 1990 6 p
(Contract DE-FG02-87ER-13671)
(DE91-005981; DOE/ER-13671/4) Avail: NTIS HC/MF A02

The formyl radical and the acetylene molecule were chosen for these studies. The visible and fluorescence spectra of the formyl radical were recorded, and the spectral results are used as a basis to explain the electronic structure. Optical-optical double resonance studies of acetylene were recorded, and the spectral results are interpreted. The results of Zeeman and Stark anticrossing and quantum beat studies of acetylene are reported, and they provide an unusually detailed view of both Intersystem Crossing and Internal Conversion in small polyatomic molecules. Twenty-two references are cited as resulting from Department of Energy sponsorship of this project. DOE

N91-18785# National Inst. for Fusion Science, Nagoya (Japan).
SOLITON ON THIN VORTEX FILAMENT
Kimiaki Konno, Masaluko Mituhashi (Kanagawa Univ., Yokahama, Japan), and Yoshi H. Ichikawa Dec. 1990 33 p
(NIFS-63; ISSN-0915-633X) Avail: NTIS HC/MF A03

Solitons on a vortex filament are investigated. An equation that is shown to be equivalent to the equation of motion of a thin vortex filament is used. An N vortex soliton solution is given in terms of the inverse scattering method. Two soliton collision processes on the filament are examined. The analysis provides the theoretical foundation of two soliton collision processes observed numerically by Aref and Flinchem. Author

N91-18786# Rutherford Appleton Lab., Chilton (England).
THE STANDARD MODEL CALCULATION OF EPSILON PRIME/EPSILON
Jonathan M. Flynn Jul. 1990 5 p Presented at PANIC 12, International Conference on Particles and Nuclei, Boston, MA, Jun. 1990
(RAL-90-049; ETN-91-98630) Avail: NTIS HC/MF A01

The calculation of epsilon prime/epsilon in the standard model is discussed with emphasis on what can be calculated and where the uncertainties lie. An effective low energy Hamiltonian, comprising scale dependent coefficients multiplying operators constructed from the light u, d, and s quark fields, is first derived. This Hamiltonian results from a renormalization group analysis which puts the large logarithms of the problem into the calculated coefficients. Matrix elements of multiplying operators are then taken. The matrix elements cannot yet be evaluated; at present they are the principle uncertainty in the prediction of epsilon prime/epsilon. ESA

N91-18787# Rutherford Appleton Lab., Chilton (England).
DEGENERATE HIGGS AND Z BOSON AT LEP200
N. Brown Aug. 1990 22 p
(RAL-90-059; ETN-91-98631) Avail: NTIS HC/MF A03

The problem of detecting the Higgs boson at LEP200, if M sub H is approximately equal to M sub Z, is investigated. The main problem is the large background from ZZ production. Since this background should be calculated, it is estimated that the existence of the Higgs can be established with about 3 f/b of integrated luminosity. Perturbation theory was applied to determine how much integrated luminosity is required, in order to establish the signal statistically. The finite widths of the particles were included in the calculation, and the final state where the Z decays into leptons and the Higgs decays to jets was considered. With large integrated luminosities and a combined analysis using event rates, angular distributions, and b tagging, it is clear that a Higgs can be observed, even if it is degenerate in mass with the Z boson at LEP200. ESA

N91-18788# Rutherford Appleton Lab., Chilton (England).
JET CROSS SECTIONS AT LEADING DOUBLE LOGARITHM IN e+e- ANNIHILATION
N. Brown and W. J. Stirling (Durham Univ., England) Aug. 1990 15 p
(RAL-90-060; DTP/90/58; ETN-91-98632) Avail: NTIS HC/MF A03

The leading double logarithm structure in the calculation of jet fractions is examined by using the JADE algorithm, based on a jet-jet mass cut ys. Perturbation theory was used and the Sudakow variables were introduced to describe the gluons. The cases where one or two gluons are unresolved from the quark or the antiquark or from both were investigated. The momenta were combined to form a pseudo three body final state. The results show that the algorithm does not allow to compare theory and experiment at the low values of y where the multijet structure is particularly interesting. ESA

N91-18789# Rutherford Appleton Lab., Chilton (England). Theory Div.
RELATIVISTIC EFFECTS IN GAMMA-GAMMA DECAYS OF P-WAVE POSITRONIUM AND QQ(BAR) SYSTEMS
F. E. Close, Z. P. Li, and T. Barnes (Tennessee Univ., Knoxville.) Aug. 1990 28 p Submitted for publication Sponsored in part by Tennessee State Science Alliance Center
(Contract DE-AS05-76ER-04936)
(RAL-90-061; UTK-90-08; ORNL-CCIP-90-04; ETN-91-98633)
Avail: NTIS HC/MF A03

Theories of the two photon coupling of P-wave positronium and qq(bar) systems are reviewed and a relationship is established between field theoretical calculations and the Vector Meson Dominance (VMD) model for both heavy and light quark systems. Relativistic corrections to the two photon decay rates are evaluated and found to be very important for the light quark system. The widely quoted ratio of 15/4 between the gamma-gamma widths of heavy-quark scalar and tensor mesons is significantly modified in the light qq(bar) sector. The helicity-zero amplitude for the gamma-gamma coupling of the tensor mesons, which vanishes in the nonrelativistic limit, remains small for light quarks in accordance with experimental observation. ESA

N91-18790# Rutherford Appleton Lab., Chilton (England).
PARTON DISTRIBUTIONS, THE GOTTFRIED SUM RULE AND THE W CHARGE ASYMMETRY
A. D. Martin, W. J. Stirling (Durham Univ., England), and R. G. Roberts Sep. 1990 9 p
(RAL-90-068; DTP/90/62; ETN-91-98634) Copyright Avail: NTIS HC/MF A02

Data from a series of precise experiments on deep inelastic scattering and hadronic production of prompt photons and dimuons are analyzed to produce sets of realistic parton distributions which can be used to make reliable predictions for many high energy reactions. Theoretical expectations in the very small x region were incorporated, such as shadowing from parton interactions. The calculations show that the input assumptions of the global structure function analyses, such as the invariance of sea quarks, are valid. The parton distributions of the literature are found to be entirely consistent with the sum rules and in excellent agreement with the new W charge asymmetry data. ESA

N91-18791*# Nebraska Univ., Lincoln. Physics Lab.
EXCITED IONIC AND NEUTRAL FRAGMENTS PRODUCED BY DISSOCIATION OF THE N2(+)* H BAND
James A. R. Samson, Y. Chung, and E.-M. Lee [1991] 11 p
(Grants NAGw-1751; NSF ATM-86-17670; NSF DMR-88-21625)
(NASA-CR-187987; NAS 1.26:187987) Avail: NTIS HC/MF A03 CSCL 20H

N I and N II fluorescent radiation was observed when N2 was irradiated by undispersed synchrotron radiation with an upper

energy limit of approximately 200 eV. The excited fragments originate from dissociation of a band of excited ionic states of N2 lying between 34.7 and 44 eV. Author

N91-18792# Pacific Northwest Lab., Richland, WA.
CONTRIBUTIONS AND FUTURE OF RADIOISOTOPES IN MEDICAL, INDUSTRIAL, AND SPACE APPLICATIONS
G. L. Tingey, G. P. Dix, and E. J. Wahlquist Nov. 1990 9 p Presented at the American Nuclear Society Winter Meeting, Washington, 11-15 Nov. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005245; PNL-SA-18458; CONF-901101-68) Avail: NTIS HC/MF A02

There are 333 isotopes that have a half-life between 1 day and 100,000 years that have a wide variety of applications including public health, medicine, industrial technology, food technology and packaging, agriculture, energy supply, and national security. This paper provides an overview of some of the most extensive applications of radioisotopes including some observations of future uses. Examples are discussed that indicate that the use of radioisotopes is almost unlimited and will continue to grow. There is a growing need for future applications development and production. DOE

N91-18793# Boston Univ., MA. Dept. of Physics.
RESEARCH ACCOMPLISHMENTS AND FUTURE GOALS IN PARTICLE PHYSICS
J. S. Whitaker Jan. 1990 127 p
(Contract DE-AC02-86ER-40284)
(DE91-007547; DOE/ER-40284/5) Avail: NTIS HC/MF A07

This document presents our proposal to continue the activities of Boston University researchers in eight projects in high energy physics research: colliding beams physics; accelerator design physics; MACRO project; proton decay project; theoretical particle physics; muon G-2 project; and hadron collider physics. The scope of each of these projects is presented in detail in this paper. DOE

N91-19002*# Washington State Univ., Pullman. Dept. of Electrical Engineering.
ELECTRON TEMPERATURE AND CONCENTRATION IN A THERMAL ATOMIC OXYGEN SOURCE
Patrick Dennis Pedrow *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N91-18794# Fermi National Accelerator Lab., Batavia, IL.
MEASUREMENT OF TIME DEPENDENT FIELDS IN HIGH GRADIENT SUPERCONDUCTING QUADRUPOLES FOR THE TEVATRON
M. J. Lamm, K. Coulter, S. Gourlay, and T. S. Jaffery Oct. 1990 5 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990
(Contract DE-AC02-76CH-03000)
(DE91-004975; FNAL-TM-1689; CONF-900944-28) Avail: NTIS HC/MF A01

Magnetic field measurements have been performed on prototype and production magnets from two high gradient superconducting quadrupole designs. One design is a double shell quadrupole with 36 strand Rutherford cable. The other design is a single shell quadrupole with 5 individually monolithic strands connected in series. These magnets have similar bore diameters and cable dimensions. However, there are significant differences between the two designs, as well as differences between prototype and production magnets within each design, with regard to Cu to superconductor ratio, filament diameter and filament spacing to strand diameter. The time dependence of fixed currents of the measured magnetic fields is discussed. DOE

N91-18795# Maryland Univ., College Park. Dept. of Electrical Engineering.
ACCELERATOR RESEARCH STUDIES Technical Progress Report, 1 Jun. 1990 - 31 May 1991
1991 186 p
(Contract DE-AC05-85ER-40216)
(DE91-005721; DOE/ER-40216/8) Avail: NTIS HC/MF A09

The progress made during the past year is discussed and the proposed research program is outlined for the next three years. The program consisted of the following three tasks: Task A, Study of Transport and Longitudinal Compression of Intense, High Brightness Beams; Task B, Study of Collective Ion Acceleration by Intense Electron Beams and Pseudospark produced High Brightness Electron Beams; and Task C, Study of a Gyroklystron High Power Microwave Source for Linear Colliders. These tasks are discussed. DOE

N91-18796# Los Alamos National Lab., NM.
STATUS OF PILAC: A PION LINAC FACILITY FOR 1-GeV PION PHYSICS AT LAMPF
Henry A. Thiessen 1990 16 p Presented at the Los Alamos Meson Physics Facility Workshop, Los Alamos, NM, 11-15 Oct. 1990
(Contract W-7405-eng-36)
(DE91-005854; LA-UR-90-4323; CONF-9010264-4) Avail: NTIS HC/MF A03

A Pion Linac (PILAC) is being designed for LAMPF. Together with its high resolution beam line and spectrometer, the system is optimized to provide 10(exp 9) pions per second on target and 200-keV resolution for the pi(+), K(+) reaction at 920, MeV. There will also be an achromatic beam line capable of utilizing the maximum energy available, thus opening up the possibility of a broad experimental program as is being discussed at this workshop. DOE

N91-18797# Lawrence Livermore National Lab., CA.
OBJECTIVES AND CONFIGURATION OF THE MULTIPLE PULSE PROPAGATION EXPERIMENT
T. J. Orzechowski, G. J. Caporaso, F. W. Chamber, Y. P. Chong, F. J. Deadrick, G. Guethlein, W. M. Fawley, V. L. Renbarger, D. Rogers, Jr., and J. T. Weir et al 1 Oct. 1990 6 p Presented at the Annual Charged Particle Beam Meeting, San Diego, CA, 11-14 Jun. 1990 Submitted for publication
(Contract W-7405-eng-48; DARPA Order-4395)
(DE91-005241; UCRL-JC-105202; CONF-9006228-6) Avail: NTIS HC/MF A02

The Multiple Pulse Propagation Experiment (MPPE) was designed to determine the hose stability properties of an intense relativistic electron beam in a beam generated density channel and to investigate range extension with increasing pulse number in the burst. This experiment used a 10-MeV electron beam generated by the Advanced Test Accelerator (ATA). The electron beam current was expected to be at least 6-kA with an equilibrium radius of 0.5 cm (RMS) in the gas. This last constraint implied an unnormalized, RMS beam emittance of 20 mrad-cm. In order to achieve beam stability against hose, each electron beam pulse had to be tailored in emittance in order to phase mix damp the instability. The initial offsets of the beam were to be kept small in order to prevent a large saturated amplitude. Numerical simulations determined the initial criteria for the emittance profile and initial beam displacements. In order to demonstrate a final density depression of 25 percent of ambient pressure, at least five pulses with interpulse separation of 1- to 2-ms were specified. DOE

N91-18798# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
GROUND-BASED TESTING OF SPACE NUCLEAR POWER PLANTS
Thomas G. McDonald 22 Oct. 1990 34 p
(Contract DE-AC07-76ID-01570)
(DE91-006179; EGG-ME-9338) Avail: NTIS HC/MF A03

Small nuclear power plants for space applications are evaluated according to their testability in this two part report. The first part introduces the issues involved in testing these power plants. Some of the concerns include oxygen embrittlement of critical components, the test environment, the effects of a vacuum environment on materials, the practically of racing an activated test chamber, and possible testing alternative the SEHPTR, king develop at the Idaho National Engineering Laboratory. DOE

N91-18799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CONSTRUCTION AND TESTING OF CERAMIC FABRIC HEAT PIPE WITH WATER WORKING FLUID
Zenen I. Antoniak, Brent J. Webb, James M. Bates, and Matthew F. Cooper Jan. 1991 7 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991 Prepared in cooperation with NASA, Lyndon B. Johnson Space Center, and Pacific Northwest Lab., Richland, WA Sponsored in part by Air Force
(Contract DE-AC06-76RL-01830)
(NASA-TM-103332; NAS 1.15:103332; DE91-006716; PNL-SA-18805; CONF-910116-16) Avail: NTIS HC/MF A02 CSCL 20H

A prototype ceramic fabric/titanium water heat pipe has been constructed and tested; it transported 25 to 80 W of power at 423 K. Component development and testing is continuing with the aim of providing an improved prototype, with a 38 micron stainless steel liner covered by a biaxially-braided Nextel (trademark) sleeve that is approximately 300 microns thick. This fabric has been tested to 800 K, and its emittance is about 0.5 at that temperature. Advanced versions of the water heat pipe will probably require a coating over the ceramic fabric in order to increase this emittance to the 0.8 to 0.9 range. DOE

N91-18800# Stanford Linear Accelerator Center, CA.
BEAMSTRAHLUNG AND QED BACKGROUNDS AT FUTURE LINEAR COLLIDERS Ph.D. Thesis
Daniel V. Schroeder Oct. 1990 101 p
(Contract DE-AC03-76SF-00515)
(DE91-006804; SU-SLAC-371) Avail: NTIS HC/MF A06

This dissertation is a detailed study of several aspects of beamstrahlung and related phenomena. The problem is formulated as the relativistic scattering of an electron from a strong but slowly varying potential. The solution is readily interpreted in terms of a classical electron trajectory, and differs from the solution of the corresponding classical problem mainly in the effect of quantum recoil due to the emission of hard photons. When the general solution is expanded for the case of an almost-uniform field, the leading term is identical to the well-known formula for quantum synchrotron radiation. The first non-leading term is negligible in all cases of interest where the expansion is valid. In applying the standard synchrotron radiation formula to the beamstrahlung problem, the effects of radiation reaction on the emission of multiple photons can be significant for some machine designs. Another interesting feature is the helicity dependence of the radiation process, which is relevant to the case where the electron beam is polarized. The inverse process of coherent electron-positron pair production by a beamstrahlung photon is a potentially serious background source at future colliders, since low-energy pairs can exit the bunch at a large angle. Pairs can also be produced incoherently by the collision of the two photons, either real or virtual. The rates, spectra, and angular distributions for both the coherent and incoherent processes are estimated here. At a 1/2 TeV machine the incoherent process will be more common, resulting in roughly 10(exp 6) pairs per bunch crossing. One member of each pair is always pushed outward, at an angle determined by its energy, by the field of the oncoming bunch. In addition, a small number of pairs are initially produced with a comparable or larger angle. DOE

N91-18801# Houston Univ., TX.
RESEARCH IN ACCELERATOR PHYSICS (THEORY)
Shoroku Ohnuma 1 Jan. 1991 10 p
(Contract DE-FG05-87ER-40374)
(DE91-006845; DOE/ER-40374/41) Avail: NTIS HC/MF A02

This report discusses the following topics: beam-beam interaction in colliders with momentum oscillation; isolated difference resonance and evolution of the particle distribution; study of magnet sorting for the SSC High Energy Booster; development of a discrete HESQ; beam dynamics in compact synchrotrons; theoretical problems in multi-stage FEL for two-beam acceleration; operation of Tevatron near integer tunes; and detailed examination of coupling impedance of various devices in storage rings; impact on beams from the insertion devices. DOE

N91-18802# Rockefeller Univ., New York, NY.
EXPERIMENTAL STUDIES OF ELEMENTARY PARTICLE INTERACTIONS AT HIGH ENERGIES Technical Progress Report, 1 Oct. 1989 - 20 Oct. 1990
N. N. Khuri 1990 33 p
(Contract DE-AC02-87ER-40325)
(DE91-006305; DOE/ER-40325/4) Avail: NTIS HC/MF A03

This report includes descriptions of the combined work of both Tasks B and B(sub 1) at Rockefeller University. Some highlights are worth stressing in this brief introduction. First, one should note the active involvement of two members of our group, Ren and Callaway, in understanding the problem of superconductivity, both high and low (Tc). This reflects the broad reach of many, but perhaps not all, particle physicists. Second, spurred by the Rockefeller environment, some in our group are also looking at problems in biology. As for our main purpose, I would like to single out the results of Sanda and Morozumi on the (Delta)I = (1/2) rule, the work of Bitar, Ren and myself on a new approach to the path integral, S.Y. Pi's results on Chern-Simons non-relativistic quantum mechanics, and finally the work by Lee and collaborators on the origin of Fermion masses and mixing. DOE

N91-18803# Groningen Rijksuniv. (Netherlands).
[ACTIVITIES REPORT OF THE KERNFYSISCH VERSNELLER INSTITUTE] Annual Report, 1989
H. Loehner, ed. 1990 194 p
(ETN-91-98764) Avail: NTIS HC/MF A09

The research activities of the Kernfysisch Versneller Institute (KVI) during 1989 are covered in this annual report. Work carried out in the following field is reviewed: experimental nuclear physics-structure (direct reactions studies, giant resources, nuclei at high spin); experimental nuclear physics-reaction mechanisms (light and heavy mass systems, models of reaction mechanisms, relativistic heavy ions); theoretical nuclear physics (nuclear structure and matter); Bhabha scattering; surface and atomic physics; environmental research (radon research and heavy minerals in coastal sand); nuclear medicine; the AGOR cyclotron project; technical developments (cyclotron and ion sources, detectors, technical support and computer systems); and publications and scientific presentations. ESA

N91-18804# Technische Univ., Delft (Netherlands). Interfacultair Reactor Institute.
[ACTIVITIES REPORT OF THE INTERFACULTAIR REACTOR INSTITUTE] Annual Report, 1989
1990 64 p
(ISSN-0924-2910; ETN-91-98772) Avail: NTIS HC/MF A04

The Interfacultair Reactor Institute (IRI) is a center for research training in which reactor, radionuclides and/or ionizing radiation play a central role. There are four research departments: radiation chemistry; radiation physics; radiochemistry and reactor physics. The following are included in the journal: the 1989 scientific report; teaching activities; large instrumentation projects; facilities; services

and staff departments; the 1989 budget; research areas and responsible staff; survey of scientific relations with universities and institutes; and a list of publications and abstracts. ESA

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N91-18805# Lawrence Livermore National Lab., CA. Chemistry and Materials Science Div.
LAYER FORMATION IN CuNi/C X RAY OPTICS
A. F. Jankowski and D. G. Stearns Nov. 1990 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26 Nov. - 1 Dec. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005229; UCRL-JC-104323; CONF-901105-40) Avail: NTIS HC/MF A02

A series of Cu/C and CuNi/C multilayer films are prepared for potential use as normal incidence x-ray reflectors. The use of a metal alloy layer is intended to enhance layer formation without metastable metallic carbide formation. The films are characterized both in composition and structure. Addition of Ni to the Cu-rich layer is seen to markedly improve the formation of continuous metal layers. DOE

N91-18806# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
THREE-DIMENSIONAL OBJECT RECOGNITION BY MONOCULAR AND MULTISENSORY PERCEPTION: SPACE ROBOTICS APPLICATION Ph.D. Thesis - Toulouse Univ.
Luc-Henry Pampagnin (Ecole des Mines, Ales, France) 1990 142 p In FRENCH; ENGLISH summary
(LAAS-90286; ETN-91-98588) Avail: NTIS HC/MF A07

Three dimensional object recognition by computer vision is studied with particular consideration to modelization and graph utilization. First a polyhedral object is identified and located from one intensity image; the model is known and the object is convex or not. The model consists of a geometrical model and the perspective projection aspect graph. Recognition was based on construction and utilization of the compatibility graph, expressing geometrical and visual constraints between matchings of high level entities (object faces). A multisensory system is described, whose main advantage is the complementarity of different kinds of information, which eliminates the limitations due to the use of one image. The system included a black and white camera and a pan and tilt scanning laser range finder. ESA

N91-18807# Tennessee Univ., Knoxville. Dept. of Chemistry.
CONSTRUCTION AND EVALUATION OF A REGENERABLE FLOUROIMMUNOCHEMICAL-BASED FIBER OPTIC BIOSENSOR
James R. Bowyer, Jean Pierre Alarie, Michael J. Sepaniak, Tuan Vo-Dinh, and Robert Q. Thompson (Oberlin Coll., OH.) 1990 30 p
(Contract DE-FG05-86ER-13613; NSF CHE-87-08581)
(DE91-004886; DOE/ER-13613/29) Avail: NTIS HC/MF A03

A microscale fiber optic biosensor that is capable of in situ regeneration is described and characterized. By combining recently developed fiber optic sensing technology with a capillary column reagent delivery system, it is possible to perform a variety of benchtop affinity assay procedures repetitively and remotely. The configuration of the sensing chamber at the terminus of the fiber is an important design feature. The construction and operation of the sensor is described and the results of evaluations of the sensor using an antibody/antigen system are presented. Affinity assay steps such as the delivery of solid phase affinity reagents, secondary reagents, and rinse solutions are demonstrated. Sampling is accomplished by mild aspiration. Coefficients of variation (CVs) for these steps are all less than 10. The capability of selectivity measuring fluorescently-labeled anti-rabbit-immunoglobulin G (IgG), in the present of a similar protein, utilizing its immunospecific interaction with rabbit-IgG beads, is demonstrated and exhibits a CV of 6.2. A near linear calibration plot is presented over a concentration range of 0.011 mg/ml.(approx. the limit of detection) to 0.11 mg/m. DOE

N91-18808# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
SCATTERING OF EVANESCENT WAVES. EXAMINATION BY USE OF LATERAL WAVES IN THE MICROSCOPE Ph.D. Thesis [STREUUNG EVANESZENTER WELLEN. UNTERSUCHUNGEN MITTELS LATERALWELLEN IN MIKROSKOP]
Harald Rehnert 1990 138 p In GERMAN
(ETN-91-98787) Avail: NTIS HC/MF A07

The scattering of small dielectric single particles was examined. These particles were situated in the field of an evanescent wave, in the direct proximity of a total reflecting dielectric boundary surface, in the optical thinner medium (air). The evanescent waves showed equal wave fronts and ran parallel to the boundary surfaces. Their amplitude decreased very quickly, in relation with the distance of the boundary surface. The scattered light parallel to the boundary surface appeared again by refraction, under the limiting angle of the total reflection in the thicker medium (glass), where this transfer produced a lateral wave. The evanescent waves were produced by a laser light pencil which was guided in a thin glass plate, e.g., the microscope cover glass. The serviceability of the model for dielectric elementary particles was examined in the field of experimentally used magnitude. ESA

N91-18305*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL DISPERSION RELATIONS FOR DIAMONDLIKE CARBON FILMS
Samuel A. Alterovitz, Robert M. Sieg, Neil S. Shoemaker (Case Western Reserve Univ., Cleveland, OH.), and John J. Pouch *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 240-245 Previously announced as N90-10738 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20F

N91-18306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DIAMONDLIKE CARBON APPLICATIONS IN INFRARED OPTICS AND MICROELECTRONICS
John A. Woollam, Bhola N. De, S. Orzeszko, N. J. Ianno, Paul G. Snyder, Samuel A. Alterovitz, John J. Pouch, R. L. C. Wu, and D. C. Ingram (Universal Energy Systems, Inc., Dayton, OH.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 246-276 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

N91-18809# National Inst. for Fusion Science, Nagoya (Japan).
US-JAPAN WORKSHOP ON COMPARISON OF THEORETICAL AND EXPERIMENTAL TRANSPORT IN TOROIDAL SYSTEMS Abstracts Only
Mar. 1990 26 p Workshop held in Nagoya, Japan, 23-27 Oct. 1989 Submitted for publication
(NIFS-PROC-1; ISSN-0915-6348) Avail: NTIS HC/MF A03

Topics addressed include: transport properties in tokamaks; improved confinement; numerical simulation of simple electron drift; drift-wave transport model; density fluctuation properties in tokamaks; confinement enhancement in tokamaks; H-mode simulation; particle simulation in internal kink modes; analysis of the relationship between local transport and global confinement in tokamaks; heliotron/torsatron transport studies; particle

simulation of ion drift instabilities; transport in scrape-off layer; and transport phenomena in ultra-long discharge. For individual titles, see N91-18810 through N91-18826.

N91-18810# Princeton Univ., NJ. Plasma Physics Inst.
KINETIC MICROINSTABILITY TRANSPORT PROPERTIES IN TOKAMAKS Abstract Only
W. M. Tang *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 2 (For primary document see N91-18809 10-75)
(Contract DE-AC02-76CH-03073)
Avail: NTIS HC/MF A03

Low frequency drift-type microinstabilities dependent on trapped electron and ion temperature gradient effects have continued to be the most commonly proposed physics-based candidates accounting for anomalous transport in the bulk region of tokamak plasmas. In order to assess their relevance, experimental studies have primarily focused on theoretical estimates of the anomalous thermal flux, the anomalous particle flux, and the density perturbation associated with these instabilities. The present work calls attention to additional important microinstability transport properties which are also amenable to experimental tests. These include ion and electron temperature fluctuation responses, anomalous momentum transport, from electron drift modes as well as from ion modes, and the anomalous energy exchange between ions and electrons, when fluctuations are present. In addition, possible current and/or q-scaling in the local thermal diffusivity, is examined with the aid of a comprehensive kinetic stability code. Preliminary results from these studies indicate: the trend of the temperature fluctuation response is greater than the density perturbation for eta(sub i) is greater the (eta sub i)(sub crit) is confirmed by detailed computations including complete trapped-electron dynamics; trapped electron drift modes can cause anomalous momentum transport with chi(sub phi) is approximately chi(sub e) is approximately chi(sub i) for a sufficiently collisionless plasma; proper evaluation of anomalous energy exchange can give results significantly different from earlier estimates which deduced a simple proportionality to the particle flux; and the local growth rate is found to scale roughly as gamma varies as q(sup alpha), with alpha is approximately 3/4 to 1.5. Author

N91-18811# National Inst. for Fusion Science, Nagoya (Japan).
MODELLING OF IMPROVED CONFINEMENT IN TOKAMAKS. A: PEAKED DENSITY PROFILE AND INWARD PINCH. B: CHANGE OF TRANSPORT AT L/H MODE TRANSITION Abstract Only
Sanae-I. Itoh and Kimitaka Itoh *In its* US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 3 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

A model of peaked density profile and inward flux of ohmic discharges in tokamaks is presented. Anomalous particle fluxes in the presence of radial electric field, E(sub r), and the radial current in the presence of plasma rotation are consistently obtained in a stationary state. Viscous damping of the differential flow due to E(sub r) balances with the particle diffusion, which determines density and E(sub r) structures. In viscous plasma, peaked profile is expected. The model theory is applied to the transition from SOC to IOC discharges. Reduction of edge neutrals changes the boundary conditions and causes the steepening of density gradient. Initiated by this, inward flux is induced and the density profile becomes peaked. Structural change of E(sub r) associated with ion viscous damping propagates into the center, causing the central ion heating. Results predict the common feature of improved confinement of density peaking. The relation of the density peaking to the improved particle confinement is also obtained. An importance of viscous damping to the density profile is emphasized. The result shows that a new column in transport matrix is necessary to understand the actual transport process in the experiment. A refined model of L/H transition in tokamaks is presented based on the bifircation of E(sub r) near edge. The radial gradient of E(sub r) is newly introduced to explain the sudden change of fluctuations as well as plasma fluxes at the onset of transition. This model predicts that L- or H-mode transition is associated with the decrease of dE(sub r)/dr causing reduction of particle and energy fluxes at critical gradient. Author

N91-18812# General Atomic Co., San Diego, CA.
THREE-DIMENSIONAL NUMERICAL SIMULATION OF SIMPLE ELECTRON DRIFT WAVE TURBULENCE IN A SHEARED AND CURVED MAGNETIC FIELD Abstract Only
R. E. Waltz *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 4 (For primary document see N91-18809 10-75)
(Contract DE-AC03-89ER-53277)
Avail: NTIS HC/MF A03

A three-dimensional code originally developed to treat eta(sub i) drift mode turbulence was used to study the scaling of a simple electron drift mode turbulence model with respect to shear and toroidicity in tokamak geometry. The code is written in an (m, n, r,) representation with bounded multiple helicities q(sub 0) is less than m/n is less tha q(sub 1). Three nonlinear equations of motion are time advanced; the ion continuity equation, ion parallel motion equation, and in hot ion cases, the adiabatic ion pressure equations. The electrons are modeled with a linear near Boltzmann response. Several new results are obtained. For cases set up to resemble a sheared slab (uniform shear and density gradient lengths Ls and Ln) and curvature terms suppressed, the results are well described by the mixing length rules for turbulence levels and diffusivity. The mixing length delta(x) varies as ps(Ls/Ln)(sup 1/2) scales as the linear harmonic mode width and the average poloidal model number scales to the gyroradius K(theta)ps is approximately constant. These results are consistent with the weak turbulence, single helicity helicity theory of Tange, Nishikawa, and Sen. The parameter space with toroidal coupling from curvature is complex. In the strong shear regime, the results appear to be consistent with a mixing length scaling as delta(x) varies as ps(Ln/R)(sup 1/2) independent of Ls and the vector s. This unexpected result contradicts theoretical conjectures based on the poloidal harmonic widths of the ballooning modes or on the spacing between singular surfaces. Apart from these scaling studies, the possibility of nonlocal convecture effects are examined. For weak turbulence cases in a nonuniform cylindrical plasma, it is found that turbulence and transport at one location can be increased by excess driving at a distance larger than an ion Landau damping length. Thus, some possibly important convective effects may be left out of local homogeneous microturbulence theories as suggested by Prakash, Chu, and Hasegawa. Author

N91-18813# Okayama Univ. (Japan). Faculty of Engineering.
DRIFT-WAVE TRANSPORT MODEL AND ROLE OF FAST PARTICLES Abstract Only
A. Fukuyama, T. Kasai, Kimitaka Itoh, and Sanae-I. Itoh (National Inst. for Fusion Science, Nagoya, Japan) *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 5 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Transport process during ICRF heating is studied with the drift-wave-turbulence (DWT) model and the results are compared with the experiments on JET. The 1-D wave code is linked to the anisotropic Fokker-Planck code and to the 1-D radial transport code. Wave excitation, propagation and absorption, fast ion generation, thermalization of the absorbed power, and spatial transport are analyzed in a consistent manner. The anomalous diffusion coefficient of the DWT model are employed for bulk electrons and ions. Coefficients are so chosen as to reproduce the ohmic discharge. The analysis shows that the presence of fast minority ions leads to the offset linear scaling of the stored energy. The increase of the tail energy compensates the saturation of the bulk energy which is roughly proportional to P(sub in). The saturation of majority ion temperature T(sub i) in a high power range is also explained. Effects of radial transport of the fast ions

is examined in a simplified model. If the thermal diffusivity of the fast ions is assumed to be the same as that of the majority ions, the heating efficiency decreases by 40 percent compared with the case where the fast ion transport is neglected. The reduced value is close to the experimentally observed one on JET.
Author

N91-18814# Princeton Univ., NJ. Plasma Physics Lab.
REVIEW OF MEASURED DENSITY FLUCTUATION PROPERTIES IN TOKAMAKS AT PPPL AND FUTURE PLANS
E. Mazzucato *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 6-7 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Since the first observation with scattering of electromagnetic waves of a low frequency, small scale turbulence in the ATC tokamak, the same microturbulence was observed in every tokamak where similar measurements were attempted. The observations on plasma microturbulence in tokamaks at the Princeton Plasma Physics Laboratory are summarized. There is at present no conclusive evidence that the observed fluctuations are induced by known plasma instabilities or that they are the cause of anomalous transport. Indeed, it is possible that the observed fluctuations are not the main (or the only) phenomena which affects the plasma confinement in tokamaks. A significant gap exists in the experimental knowledge of long wavelength fluctuations with scale size between those of fluctuations which are detectable with scattering techniques and those visible on soft x ray or interferometric signals. Microwave reflectometry is a technique which offers the possibility of high resolution detection of long wavelength plasma fluctuations. This technique, used on the ATC for the first time in a tokamak, can be considered a special kind of interferometer where the phase of the received wave is determined by both the change of the refractive index along the wave trajectory and by the shift of the reflecting layer. The latter becomes the dominant effect when the scale size of the plasma fluctuation is 3 to 4 times larger than the wavelength of the probing wave. Hence, by using the extraordinary mode of propagation in a TFTR-like tokamak, microwave reflectometry should provide spatially resolved information about plasma fluctuations which presently are not detectable with other diagnostic techniques.
Author

N91-18815# National Inst. for Fusion Science, Nagoya (Japan).
MEASUREMENT OF DENSITY FLUCTUATIONS IN THE JIPP T-IIU TOKAMAK Abstract Only
K. Kawahata, Y. Hamada, and S. Okajima (Chubu Univ., Kasugai, Japan) *In its* US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 8 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Low frequency density fluctuations caused by the microstabilities which universally exist in tokamak plasmas were considered to enhance particle and energy losses of the confined plasma across the magnetic field. For the study of the microinstabilities, it is necessary to know their characteristics; frequency and wave number spectra, spatial distribution, and absolute level of density fluctuations. The collective scattering method with submillimeter waves is an ideal means for the study of microinstabilities in a tokamak plasma. In the JIPP T-IIU tokamak, a HCN laser scattering system with a heterodyne detection was developed. The main radiation source is a 5 m long HCN laser which delivers a linearly polarized beam of 0.5 W with a wave length lambda(sub i) = 337 microns. For the heterodyne detection another HCN laser is operated as a local oscillator at the beat frequency of 2 MHz. In low density ohmically heated (OH) plasma, the density fluctuations mainly propagate in the direction of the electron diamagnetic drift, and the peak in the power spectra shows a linear dispersion relation for various wavenumber. In high density OH plasmas, it was found that the energy confinement time deviates from the Alcator scaling and at the same time the ion mode which propagates in the ion diamagnetic drift direction is excited in addition to the electron mode. The value of eta(sub i) = (dlT(sub i)/dlnn(sub i)) evaluated experimentally is about 1.0 to 1.2 when the ion mode is excited. Effects of an ice pellet injection on the instabilities and electron density profiles will be also discussed.
Author

N91-18816# Oak Ridge National Lab., TN.
THE ROLE OF THE RADIAL ELECTRIC FIELD IN PRODUCING CONFINEMENT ENHANCEMENT IN TOKAMAKS Abstract Only
K. C. Shaing *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 9 (For primary document see N91-18809 10-75)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A03

The radial variation of the poloidal E x B drift frequency can lead to an effective enhancement of the decorrelation rate between adjacent fluid elements when turbulence is present. Simple clump estimates for fluid pressure and resistivity gradient-driven turbulence suggest that a more negative value of E(sub r) can reduce the magnitude of fluctuation spectrum, for the usual case of dP/dr is less than dT/dr is less than 0. These estimates are in agreement with preliminary numerical calculations and suggest various mechanisms for improving plasma energy confinement, based on directly controlling the sign of the radial electric field.
Author

N91-18817# Japan Atomic Energy Research Inst., Naka. Dept. of Large Tokamak Research.
TRANSPORT ANALYSIS ON JT-60 Abstract Only
H. Shirai, T. Hirayama, and M. Azumi *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 10 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Ion temperature profiles of neutral beam heated plasmas in JT-60 were studied by using thermal diffusivity based on the ion temperature gradient mode (eta(sub i) mode) turbulence. The ion temperature profile is calculated by using a one dimensional tokamak transport code, while the other plasma parameters such as the electron density, the electron temperature, the effective charge number, and the power deposition profile are fixed. The calculated ion temperature profile is compared with the experimental data measured by charge exchange recombination reaction. Two different formula of Chi(sub i) based on eta(sub i) mode turbulence were adopted. The results of the calculation show that the profile of ion temperature becomes similar to that of the density profile. That is, flat density profile accompanies flat ion temperature profile and pedestal density profile accompanies pedestal ion temperature profile in the calculation. The situation is almost the same for both Chi(sub i) models.
Author

N91-18818# Princeton Univ., NJ. Plasma Physics Lab.
DIAGONAL AND OFF-DIAGONAL ANOMALOUS TRANSPORT COEFFICIENTS IN TOKAMAKS Abstract Only
G. Rewoldt *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 11 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

It has often been assumed that the anomalous transport from saturated plasma instabilities is diffusive in the sense that the particle flux, Gamma, the electron energy flux, q(sub e), and the ion energy flux, q(sub i), can be written in forms that are linear in the density gradient, dn/dr, the electron temperature gradient, dT(sub e)/dr, and the ion temperature gradient dT(sub i)/dr. In the simplest form, Gamma = -D(sub n)(sup n)(dn/dr), q(sub e) = -D(sub e)(sup e)n(dT sub e/dr), and q(sub i) = - D(sub i)(sup i)n(dT sub i/dr). A possible generalization of this is to include so-called off-diagonal terms, with Gamma = nV(sub n) - D(sub n)(sup n)(dn/dr) - D(sub n)(sup e)(n/T sub e)(dT sub e/dr) -D(sub n)(sup i)(n/T sub i)(dT sub i/dr), with corresponding forms for the energy fluxes. Here, general results for the quasilinear particle and energy fluxes, resulting from tokamak linear microinstabilities,

are evaluated to assess the relative importance of the diagonal and the off-diagonal terms. A further possible generalization is to also include contributions to the fluxes from higher powers of the gradients, specifically quadratic contributions proportional to (dn/dr)squared, (dn/dr)(dT sub e/dr), and so on. A procedure is described for evaluating the corresponding coefficients, and results are presented for illustrative, realistic tokamak cases. Qualitatively, it is found that the off-diagonal diffusion coefficients can be as big as the diagonal ones, and that the quadratic terms can be larger than the linear ones. The results thus strongly suggest that the commonly used diffusive approximation with only diagonal terms, Gamma = -D(sub n)(sup n)(dn/dr), and correspondingly for the energy fluxes, is not adequate in practice. Author

N91-18819# Japan Atomic Energy Research Inst., Ibaraki.
STUDY ON H-MODE AND IMPROVED CONFINEMENT IN JFT-2M Abstract Only
T. Fujita, K. Ida, N. Ohyabu, A. Haward, and A. Leonard (General Atomic Co., San Diego, CA.) *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 12 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

The H-mode was achieved in many tokamak devices. However, the H-mode has a problem to be overcome. H-mode in a stationary state has never been obtained without frequent ELMs so far. A plasma density continues to increase during the H-mode until the H-mode is terminated by itself. One way was found to achieve a stationary improved confinement state in JFT-2M. This type of improved confinement mode was obtained after a termination of H-mode in both divertor and limiter discharges. The density and the temperature have peaked profiles compared with those in the H-mode. The confinement improvement is realized mainly in the core region. Since edge phenomena are similar to those in the L-mode and the edge confinement is not improved, this mode is called the Improved L-mode (IL-mode). Sawtooth is always suppressed in the IL-mode, and its suppression seems to be essential to obtain the IL-mode. The value of the surface safety factor qs also affects the onset of the IL-mode, because sawtooth activity is affected by qs. It was necessary for achieving the long IL-mode that the value of qs is around 3 in the single null divetor configuration in JFT-2M. It seems that a high density at the center is also necessary for the IL-mode. This is probably a reason why the IL-mode is observed only after a long pulse H-mode which makes the central density high enough. Impurity profile (titanium) is compared with impurity transport code (MIST). Particle transport of H-mode is greater than that of IL-mode in the core region. It seems to be shown within experimental accuracy that an inward velocity of impurity ion is approximately neoclassical in the core region of IL-mode, but the particle diffusion coefficient is still greater than the neoclassical one. Another way is being tried to achieve stationary state in the H-mode with Elgodic Magnetic Limiter (EML) (m/n = 7/1,7/2). Preliminary results show that EML can reduce the density rise in the H-mode. In some cases, the stationary H-mode with ELMs has been established. Author

N91-18820# Japan Atomic Energy Research Inst., Ibaraki.
H-MODE SIMULATION Abstract Only
K. Shimizu, T. Hirayama, H. Shirai, and M. Azumi *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 13 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

H-mode phenomena has improved the degraded energy confinement in the auxiliary heating phase. A number of efforts were made experimentally and theoretically to understand the mechanism of the H-mode. However the H-mode mechanisms has not been understood well. A model was proposed to explain the H-mode transition. According to this model, which takes into account the effect of the radial electric field E(sub r) on the particle diffusion, the plasma edge has the bifurcation nature in the particle fluxes associated with the change in R(sub r). This model is incorporated into the one dimensional transport code. The H-mode transition observed in JT-60 diverter discharge with the outside X-point is investigated numerically by using this code. It is shown that the threshold power for the H-mode transition and the threshold density agrees well with the experimental data. The change of the plasma parameter after the transition is also investigated. The simulation results show that the edge parameter plays an important role in the H-mode transition. The transition condition of the plasma edge parameter obtained experimentally in JT-60 and JET was also shown. The clear threshold in the edge density and the edge temperature is observed for the H-mode transition. Both the threshold temperature and threshold density increases with the plasma current, I(sub p). Author

N91-18821# Yamaguchi Univ. (Japan).
THE 3-D GYROKINETIC PARTICLE SIMULATION ON INTERNAL KINK MODES Abstract Only
H. Naitou, R. D. Sydora, and W. W. Lee (Princeton Univ., NJ.) *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 14 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

The three dimensional gyrokinetic particle simulation code for the finite beta plasmas was completed and applied to the internal kink mode simulation. Basic equations are given. The system is a rectangular slab surrounded by the perfectly conducting wall in the x- and y-directions. A strong external magnetic field is assumed in the z-direction and a periodic boundary condition is employed in this direction. Transverse magnetic fields are generated self-consistently by the internal current produced by the electron drifting in the z-direction. The compressional component of the magnetic field is neglected in the low beta approximation. The particle dynamics parallel to the magnetic field are followed as well as the E x B drift. The electron gyroradius is assumed to be zero whereas the ion finite Larmor radius effects are properly included. The electrostatic potential is calculated from the gyrokinetic Poisson equation in which the ion polarization shielding effect is incorporated. The z-component of the vector potential is calculated by Ampere's law. The formulation using the canonical momentum is employed in which the inductive electric field does not appear explicit. For the test of the code, the dispersion relations of the shear Alfven waves were verified without the internal current as well as the energy conservation properties. Author

N91-18822# Oak Ridge National Lab., TN.
NUMERICAL ANALYSIS OF THE RELATIONSHIP BETWEEN LOCAL TRANSPORT AND GLOBAL CONFINEMENT IN TOKAMAKS Abstract Only
W. A. Houlberg, S. E. Attenberger, H. C. Howe, and N. A. Uckan *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 15 (For primary document see N91-18809 10-75)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A03

The global energy confinement time tau(sub E) is widely used to characterize the confinement efficiency of tokamaks. Its use as a guide to deducing the dependence of the local heat diffusivity Chi on plasma parameters is limited by the presence of many non-diffusive processes which themselves have strong parametric and profile dependencies. Radiation losses, heating profile effects, and the cynergistic effects they produce can obscure the parametric dependence of Chi resulting from regression analysis. Correlations between operating parameters (e.g., density and current interrelation) further weaken the deducible relationship between tau(sub E) and Chi. This relationship was examined using the detailed physics of the WHIST code. Data from this code are loaded into a LOCUS database and processed in a similar manner to actual experimental data, to deduce global confinement laws. Examples of Ohmic, neutral beam, and RF heating are computed to illustrate the importance of profile and synergistic effects when deducing tau(sub E) and Chi. Author

N91-18823# Kyoto Univ. (Japan). Plasma Physics Lab.
ANOMALOUS TRANSPORT STUDIES FOR HELIOTRON/TORSATRON Abstract Only
M. Wakatani, M. Yagi, H. Sugama, K. Watanabe, A. Hasegawa, B. G. Hong, and W. Horton (Texas Univ., Austin.) *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 16 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Recently Heliotron E experiments showed the electron thermal transport is anomalous for almost all plasma parameters particularly in the edge plasmas. For the heliotron/torsatron configuration with a bad average curvature, g mode turbulence is the most probable candidate to explain the edge anomalous transport. Another candidate is the collisional drift wave turbulence. Fluid model equations were developed describing a drift interchange mode or a coupling between the g mode and the collisional drift wave. As a nonlinear phenomenon of the drift interchange mode, an appearance of zonal flow in a cylindrical plasma model was pointed out. Also the scale invariance and the two point renormalization theory were applied to the drift interchange turbulence. It is shown that the collision drift wave turbulence gives a pseudoclassical diffusion which is larger than the diffusion based on the electrostatic g mode turbulence. A possibility of anomalous ion thermal transport in heliotron/torsatron was discussed based on the eta(sub i) mode coupled to the g mode. The bad average curvature destabilizes the new ion pressure gradient driven drift mode for wide parameter regions. An indication of the anomalous thermal transport in Heliotron E was shown. Author

N91-18824# Princeton Univ., NJ. Plasma Physics Lab.
GYROKINETIC PARTICLE SIMULATION OF ION TEMPERATURE GRADIENT DRIFT INSTABILITIES Abstract Only
W. W. Lee *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 17 (For primary document see N91-18809 10-75)
(Contract DE-AC02-76CH-03073)
Avail: NTIS HC/MF A03

Ion temperature gradient drift instabilities in sheared slab geometry were investigated using gyrokinetic particle simulation techniques. The results from a three-dimensional simulation with multiple rational surfaces indicate that the fluctuation spectrum for the electrostatic potential is dominated by the fundamental radial eigenmodes with moderate poloidal wavelength of K(theta)p(sub s) is equal to or less than 1, and the steady state thermal flux is considerably smaller than the (quasilinear) flux at the onset of saturation. It is also found that the corresponding thermal diffusivity, Chi(sub i), is weakly dependent on the shear scale length, L(sub S). To have a better understanding of these issues in less turbulent situations, simulation were performed in two dimensions for which there is only one single rational surface present. It is found that nonlinear wave-particle interactions are important for the eigenmode formation and that the nonlinear E x B advection enhances the outward energy propagation for the higher harmonics of the radial modes. As for the thermal flux, simulation in a 2D shearless slab have exhibited the same behavior as the 3D sheared cases. Based on these simulation results, some theoretical understanding was developed for the nonlinear saturation of the instability and the ensuing transport. For example, the zero frequency ion parallel velocity and pressure generated by the E x B nonlinearity are found to be related to the saturation. From the entropy balance properties of the gyrokinetic equations, the importance of the collisionless and collisional dissipation can be ascertained for steady state transport. The shear scaling trend on Chi(sub i) can be understood from the alpha/k(perpendicular) squared argument. Author

N91-18825# National Inst. for Fusion Science, Nagoya (Japan).
TRANSPORT IN SCRAPE-OFF LAYER AND ITS EFFECT ON CORE CONFINEMENT Abstract Only
Kimitaka Itoh and Sanae-I. Itoh *In its* US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 18 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

The importance of the role of edge plasmas for core confinement has recently been widely recognized. The modeling of the H-mode and improved confinement has shown that how the population of the neutral particles changes the core plasma and how important the edge plasma parameters are. The edge parameters are also important for L-mode plasma. The connections of the local plasma transport with the global scaling and the plasma profile were discussed, but the role of the boundary condition was not clarified. For instance, assume that the local thermal conductivity strongly increases when the gradient of the temperature exceeds the critical value, the absolute value of a(del)T/T is greater than f (a is the minor radius). In such a case, the plasma temperature shows a profile resiliency to the form T = T(a)exp (integral of r(sup a) fdr). The global confinement time dictates how the edge plasma parameter depends on the heating power. The UEDA (unified edge divertor analysis) code was applied to the tokamak with poloidal divertor configuration. This code solves the plasma and neutral profiles in the SoL and divertor regions for given heat and particle sources from the core plasma. It is assumed that the parallel conduction is classical and perpendicular conduction is Bohmlike. Performing the numerical simulation, it was found that the edge temperature scales as T(a) varies as P(sub out)(sup -0.25). The weak dependence of T(a) on heating power is confirmed. This dependence of T(a) and the T dependence of thermal conductivity lead the L-mode scaling and similarity in the temperature profiles. Author

N91-18826# Kyushu Univ., Fukuoka (Japan). Advanced Fusion Research Center.
TRANSPORT PHENOMENA IN ULTRA-LONG DISCHARGE Abstract Only
Sanae-I. Itoh, N. Hiraki, Y. Nakamura, K. Nakamura, A. Nagao, S. Moriyama, E. Jotaki, and S. Kawasaki *In* National Inst. for Fusion Science, US-Japan Workshop on Comparison of Theoretical and Experimental Transport in Toroidal Systems Mar. 1990 p 19 (For primary document see N91-18809 10-75)
Avail: NTIS HC/MF A03

Steady-state tokamak operation is one of the important issues for realizing a tokamak power reactor, and it would require noninductive current drive of the full plasma current. The experiments on steady-state tokamak operation have been successfully performed in the superconducting tokamak TRIAM-1M and an ultra-long operation for more than 7 minutes was achieved by lower hybrid current drive. The ultra-long tokamak operation and the confinement properties of the steady-state current-drive plasma are reported. In the first stage of the experiments on steady-state operation, the plasma position control was performed by a conventional method with magnetic probes and the plasma discharge duration was extended up to 3 minutes. In the second stage, a new method with Hall generators for the plasma position control was developed and the ultra-long tokamak operation for more than 7 minutes was achieved. These long duration discharges were obtained by the precise plasma position control and the gas feed control for keeping the plasma density constant. In order to study the confinement properties of the steady-state current-drive plasma, the confinement of high energy electrons and bulk plasma, and the impurity behavior are investigated. The radial profiles of the hard x ray emission indicated that the high energy electrons exist mainly within the inner region of the plasma column in a typical long-duration discharge. The variation of the profile for the parameter scans can be explained by the accessibility effect and the confinement properties of the high energy electrons. Author

N91-18827# Wisconsin Univ., Madison. Plasma Physics Research.
EDGE FLUCTUATIONS IN THE MST (MADISON SYMMETRIC TORUS) REVERSED FIELD PINCH
A. Almagri, S. Assadi, J. Beckstead, G. Chartas, N. Crocker, D. DenHartog, R. Dexter, S. Hokin, D. Holly, and E. Nilles et al Oct.

1990 13 p Presented at the Workshop on Physics of Alternative Magnetic Confinement Schemes, Varenna, Italy, 14-15 Oct. 1990
(Contract DE-FG02-85ER-53198)
(DE91-004923; DOE/ER-53198/164; CONF-9010209-8) Avail: NTIS HC/MF A03

Edge magnetic and electrostatic fluctuations are measured in the Madison Symmetric Torus (MST) reversed field pinch. At low frequency (less than 25 kHz), the mode number spectra of magnetic fluctuations agree very well with theoretical prediction for nonlinearly saturated tearing fluctuations resonant in the core. At high frequency (50 kHz to 100 kHz) the magnetic spectra broaden and the modes become resonant in the reversal region. Nonlinear phenomena are under experimental investigation. The low frequency fluctuations phase-lock together to produce a rotating localized disturbance. Bi-spectral analysis in frequency also reveals nonlinear three-wave mode-coupling at low frequency. Electrostatic fluctuations are substantial and do not appear to obey a Boltzmann relation. From measurements of the fluctuating density, temperature, and potential we infer that the electrostatic fluctuation induced transport of particles and energy can be substantial. DOE

N91-18828# Maryland Univ., College Park. Lab. for Plasma Research.
EXPERIMENTAL STUDY OF LAYER MIXING, RELATIVE IONIC ESCAPE VELOCITY, AND ELECTRON TEMPERATURE GRADIENTS IN SPHERICAL MULTILAYERED TARGETS BY XUV SPECTROSCOPY Final Report, Jan. 1989 - May 1990
H. R. Griem Jul. 1990 3 p
(Contract DE-FG03-89SF-18011)
(DE91-005034; DOE/SF-18011/1) Avail: NTIS HC/MF A01

This past year we have undertaken experiments at the University of Rochester's Laboratory for Laser Energetics investigating layer mixing and expansion velocities of spherical targets uniformly irradiated by high intensity laser light. We performed high resolution spectroscopic measurements of spherical plasmas, produced using the Omega laser, and have observed enhanced broadening of XUV emission lines due to the expansion velocities. DOE

N91-18829# George Washington Univ., Washington, DC. Office of Sponsored Research.
NEW HIGH TEMPERATURE PLASMAS AND SAMPLE INTRODUCTION SYSTEMS FOR ANALYTICAL ATOMIC EMISSION AND MASS SPECTROMETRY Progress Report, 1 Jan. - 31 Dec. 1990
Akbar Montaser 1990 8 p
(Contract DE-FG05-87ER-13659)
(DE91-005043; DOE/ER-13659/4) Avail: NTIS HC/MF A02

In this project, new high temperature plasmas and new sample introduction systems are developed for rapid elemental and isotopic analysis of gases, solutions, and solids using atomic emission spectrometry (AES) and mass spectrometry (MS). These devices offer promise of solving singularly difficult analytical problems that either exist now or are likely to arise in the future in the various fields of energy generation, environmental pollution, biomedicine and nutrition. Emphasis is being placed on: generation of annular, helium inductively coupled plasmas (He ICPs) that are suitable for atomization, excitation, and ionization of elements possessing high excitation and ionization energies, with the intent of enhancing the detecting powers of a number of elements; diagnostic studies of high-temperature plasmas to quantify their fundamental properties, with the ultimate aim to improve analytical performance of atomic spectrometry; development and characterization of new sample introduction systems that consume microliter or microgram quantities of samples, and investigation of new membrane separators for striping solvent from sample aerosol to reduce various interferences and to enhance sensitivity in plasma spectrometry. DOE

N91-18830# Tennessee Univ., Tullahoma. Space Inst.
AN INNOVATIVE DEMONSTRATION OF HIGH POWER DENSITY IN A COMPACT MDH (MAGNETOHYDRODYNAMIC) GENERATOR Final Report
H. J. Schmidt, J. T. Lineberry, and J. N. Chapman Jun. 1990 119 p
(Contract DE-AC22-87PC-79678)
(DE91-005526; DOE/PC-79678/T4) Avail: NTIS HC/MF A06

The present program was conducted by the University of Tennessee Space Institute (UTSI). It was by its nature a high risk experimental program to demonstrate the feasibility of high power density operation in a laboratory scale combustion driven MHD generator. Maximization of specific energy was not a consideration for the present program, but the results have implications in this regard by virtue of high energy fuel used. The power density is the ratio of the electrical energy output to the internal volume of the generator channel. The MHD process is a volumetric process and the power density is therefore a direct measure of the compactness of the system. Specific energy, is the ratio of the electrical energy output to consumable energy used for its production. The two parameters are conceptually interrelated. To achieve high power density and implied commensurate low system volume and weight, it was necessary to use an energetic fuel. The high energy fuel of choice was a mixture of powdered aluminum and carbon seeded with potassium carbonate and burned with gaseous oxygen. The solid fuel was burned in a hybrid combustion scheme wherein the fuel was cast within a cylindrical combustor in analogy with a solid propellant rocket motor. Experimental data is limited to gross channel output current and voltage, magnetic field strength, fuel and oxidizer flow rates, flow train external temperatures and combustor pressure. Similarly, while instantaneous oxidizer flow rates were measured, only average fuel consumption based on pre and post test component weights and dimensions was possible. DOE

N91-18831# Auburn Univ., AL. Dept. of Physics.
EXPERIMENTAL STUDIES OF PLASMA FLUCTUATIONS USING ELECTRON CYCLOTRON EMISSION ON ATF (ADVANCED TOROIDAL FACILITY) AND TEXT (TEXAS EXPERIMENTAL TOKAMAK) Progress Report
Rex Gandy Nov. 1990 6 p
(Contract DE-FG05-90ER-54085)
(DE91-005917; DOE/ER-54085/1) Avail: NTIS HC/MF A02

The great stumbling block in the quest for fusion power using magnetic confinement devices is anomalous transport. It is conjectured that turbulent plasma fluctuations may be responsible for the degraded energy confinement observed in experiments. There exists a clear need for more detailed experimental studies of plasma microturbulence. A set of experiments were started to measure electron temperature and density fluctuations using electron cyclotron emission (ECE). The ECE systems will use autocorrelation and cross correlation techniques to measure radiation from the Advanced Toroidal Facility at Oak Ridge National Laboratory (ORNL) and also from the Texas Experimental Tokamak (TEXT) at the University of Texas. This set of experiments on a stellerator and a tokamak will allow a unique comparative study of the fluctuation physics in the two different magnetic configurations. DOE

N91-18832# Los Alamos National Lab., NM.
FLIP-MHD: A PARTICLE-IN-CELL METHOD FOR MAGNETOHYDRODYNAMICS
J. U. Brackbill 1990 5 p Presented at the US-Japan Workshop on Advances in Simulation Techniques Applied To Plasmas and Fusion, Los Angeles, CA, 26-28 Sep. 1990
(Contract W-7405-eng-36)
(DE91-005940; LA-UR-90-4391; CONF-9009269-5) Avail: NTIS HC/MF A01

A particle-in-cell (PIC) method, FLIP is extended to magnetohydrodynamic (MHD) flow in two dimensions. Particles are used to reduce computational diffusion of the magnetic field. FLIP is an extension of classical PIC, where particles have mass, but every other property of the fluid is stored on a grid. In FLIP, particles have every property of the fluid, so that they provide a complete Lagrangian description not only to resolve contact discontinuities but also to reduce computational diffusion of linear and angular momentum. The interactions among the particles are

calculated on a grid, for convenience and economy. The present study extends FLIP to MHD, by including information about the magnetic field among the attributes of the particles. DOE

N91-18833# Lawrence Livermore National Lab., CA.
THE 3 DIMENSIONAL RADIATION TRANSPORT IN DISPERSIVE MEDIA
Ronald W. Mayle Nov. 1990 11 p Presented at the Nuclear Explosives Code Developers' Conference, Monterey, CA, 6-9 Nov. 1990
(Contract W-7405-eng-48)
(DE91-005239; UCRL-JC-105280; CONF-9011149-4) Avail: NTIS HC/MF A03

In plasmas the collective motion of free electrons affects the propagation of radiation by bending the light ray trajectory. The closer the light wave frequency is to the electron plasma frequency in value, the more pronounced the effect. We will present the results of radiation transport calculations in 3 spatial dimensions in the refractive plasma environment and compare the calculation to one done where the ray bending has been neglected (straight line ray paths). We also present the numerical method used for the refractive transport. DOE

N91-18834# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
THE MEASUREMENT OF SINGLE PARTICLE TEMPERATURE IN PLASMA SPRAYS
J. R. Fincke, W. D. Swank, P. P. Bolsaitis, and J. F. Elliott (Massachusetts Inst. of Tech., Cambridge.) 1990 9 p Presented at the 8th Symposium on Energy Engineering Sciences: Micro/Macro Studies of Multiphase Media, Argonne, IL, 9-11 May 1990
(Contract DE-AC07-76ID-01570)
(DE91-006135; EGG-M-90196; CONF-9005183-4) Avail: NTIS HC/MF A02

A measurement technique for simultaneously obtaining the size, velocity, temperature, and relative number density of particles entrained in high temperature flow fields is described. In determining the particle temperature from a two-color pyrometry technique, assumptions about the relative spectral emissivity of the particle are required. For situations in which the particle surface undergoes chemical reactions the assumption of grey body behavior is shown to introduce large Temperature measurement uncertainties. Results from isolated, laser heated, single particle measurements and in-flight data from the plasma spraying of WC-Co are presented. DOE

N91-18835# Oak Ridge National Lab., TN.
FEASIBILITY STUDIES FOR AN ECR-GENERATED PLASMA STRIPPER: PRELIMINARY
G. D. Alton, R. A. Sparrow, and R. E. Olson (Missouri Univ., Rolla.) 1990 18 p Presented at the 10th International Workshop on ECR Ion Sources, Knoxville, TN, 1-2 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE91-006649; CONF-9011136-4) Avail: NTIS HC/MF A03

Computational studies of the principal electron capture and loss processes which take place during interactions between a multi-electron projectile and a target in various degrees of ionization were initiated. These studies are designed to determine the feasibility of a plasma stripper as a possible alternative to the gaseous and foil strippers which are commonly used to enhance the charge states of energetic ion beams. The idea is based on the knowledge that the stopping powers (energy loss per unit path length) are greater for a plasma than a gaseous stripper at equivalent line densities, and the number of electron channels available for capture by the projectile are reduced when the target is highly ionized. Preliminary results of attempts to evaluate the merits of a plasma for this applications are given. DOE

N91-18836# California Univ., Los Angeles. Dept. of Physics.
ENERGETIC PARTICLE PRODUCTION, CAVITION FORMATION, AND NONLINEAR DEVELOPMENT AT A PLASMA DENSITY MAXIMUM Final Report, 16 Jun. 1989 - 15 Jun. 1990
A. Y. Wong and B. S. Bauer Sep. 1990 10 p Presented at the 19th Anomalous Absorption Conference, Durango, CO, Jun. 1989; and at the 31st Annual Meeting of the Division of Plasma Physics of APS, Anaheim, CA, Nov. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006683; UCRL-CR-105807) Avail: NTIS HC/MF A02

We have investigated several phenomena of importance to laser-plasma interactions. In our studies, these are modeled by microwave and RF-plasma interactions. Our focus has been on resonant absorption of intense electromagnetic radiation at the plasma critical layer. Electron plasma wave (EPW) growth and caviton formation have been shown to be most efficient for shallow density gradients at the critical layer, where EPW convection losses are minimized. EPW electric field energies of 5000 times the plasma thermal energy, and energetic electron tails out to 5000T(sub e), have been observed at the top of an inverse parabolic density profile. Ions receive delta-function-like impulses from localized electron plasma waves and wave-breaking electron ejection; the disruption of the ion fluid can only partially be described by the ponderomotive force. Our attempt is to test and illuminate some of the fundamental concepts of strong turbulence and EM wave-plasma interaction. DOE

N91-18837# Columbia Univ., New York, NY. Dept. of Applied Physics.
HIGH BETA TOKAMAK RESEARCH AND PLASMA THEORY Progress Report, 8 Nov. 1989 - 1 Nov. 1990
1990 21 p
(Contract DE-FG02-86ER-53222)
(DE91-006908; DOE/ER-53222/1) Avail: NTIS HC/MF A03

Our activities on High Beta Tokamak (HBT) Research during the past 12 months of the present budget period can be divided into four areas: completion of kink mode studies in HBT; completion of carbon impurity transport studies in HBT; design of HBT-EP; and construction of HBT-EP. Each of these is described briefly in the sections of this progress report. DOE

N91-18838# National Inst. for Fusion Science, Nagoya (Japan).
ELECTRIC FIELD PROFILE OF CHS HELIOTRON TORSATRON PLASMA WITH TANGENTIAL NEUTRAL BEAM INJECTION
K. Ida, H. Yamada, H. Iguchi, S. Hidekuma, H. Sanuki, and K. Yamazaki Oct. 1990 16 p
(NIFS-60; ISSN-0915-633X) Avail: NTIS HC/MF A03

The radial electric field profiles derived from poloidal rotation velocity are compared with neoclassical estimates for a plateau regime plasma heated by tangentially injected neutral beam in CHS heliotron/torsatron device. The measured electric field (E sub r) is more negative than the neoclassical prediction especially near the plasma periphery. A gradient of radial electric field, dE(sub r)/dr, (where d = partial derivative) in this region is found to be more negative in the plasma with higher electron density. Although the corresponding poloidal rotation velocity is too small to trigger the L/H transition, these negative E sub r and dE(sub r)/dr are associated with a reduction of thermal electron conductivity.
Author

N91-18839# National Inst. for Fusion Science, Nagoya (Japan).
TWO- AND THREE-DIMENSIONAL BEHAVIOR OF RAYLEIGH-TAYLOR AND KELVIN-HELMHOLTZ INSTABILITIES
T. Yabe and H. Hoshino (Gunma Univ., Maebashi, Japan) Oct. 1990 12 p
(NIFS-61; ISSN-0915-633X) Avail: NTIS HC/MF A03

Two and three dimensional behavior of the R-T and K-H instabilities is examined with a newly developed hydrodynamic code. The mushroom structure owing to the K-H instability is quite different in two and three dimensions. The simulation without gravity

shows similar behavior and hence this difference between two and three dimensions does not originate from the R-T instability. The difference cannot be explained by a linear analysis on the K-H instability. Author

N91-18840# National Inst. for Fusion Science, Nagoya (Japan).
IMPACT OF IMPROVED CONFINEMENT ON FUSION RESEARCH
Kimitaka Itoh, Sanae-I. Itoh, and A. Fukuyama (Okayama Univ., Japan) Dec. 1990 40 p
(NIFS-64; ISSN-0915-633X) Avail: NTIS HC/MF A03

The effect of the improvement of the plasma confinement on fusion research is investigated for the ITER grade plasma. The impact of the confinement improvement is quantitatively evaluated from the viewpoints of necessity and cost, the engineering research and development, the economic potential, and reduction of the ambiguity in the design of future devices. It is shown that confinement improvement has a strong and favorable influence on these aspects. Author

N91-18841# National Inst. for Fusion Science, Nagoya (Japan).
A CONSISTENCY ANALYSIS ON THE TOKAMAK REACTOR PLASMAS
A. Fukuyama (Okayama Univ., Japan), Sanae-I. Itoh, and Kimitaka Itoh Dec. 1990 24 p
(NIFS-65; ISSN-0915-633X) Avail: NTIS HC/MF A03

The parameter regime which simultaneously fulfills the various physics constraints are looked for in the case of ITER grade tokamaks. The consistency analysis code is applied. It is found that if the energy confinement time reaches 1.6 times the prediction of the L-mode scaling law, the Q-value of about 4 is possible for the full current drive operation at the input power P sub in of 100 MW (Q is the ratio of fusion output and P sub in). In the ignition mode where half of the current is inductively sustained, Q approaches to 15 for this circulating power. If only the L-mode is realized, Q is about 1.5 for P sub in approximately 100 MW. Author

N91-18842# National Inst. for Fusion Science, Nagoya (Japan).
EFFECT OF RADIAL ELECTRIC FIELD ON ALPHA-PARTICLE LOSS IN TOKAMAKS
Kimitaka Itoh, H. Sanuki, Sanae-I. Itoh, and K. Tani (Japan Atomic Energy Research Inst., Ibaraki.) Dec. 1990 21 p
(NIFS-66; ISSN-0915-633X) Avail: NTIS HC/MF A03

The effect of the radial electric field near the plasma edge on the ripple-trapped loss of fusion alpha particles is discussed. The order of magnitude of the potential difference, which substantially affects the localized wall heat load, is also studied. If the potential difference is of the order of the plasma temperature, the peaking of the localized heat deposition on the first wall becomes weaker owing to the energy distribution of the ripple-trapped loss particles. Author

N91-18843# National Inst. for Fusion Science, Nagoya (Japan).
EFFECTS OF A NONUNIFORM OPEN MAGNETIC FIELD ON THE PLASMA PRESHEATH
Kunihiro Sato and Fujio Miyawaki (Himeji Inst. of Tech., Japan) Jan. 1991 25 p
(NIFS-67; ISSN-0915-633X) Avail: NTIS HC/MF A03

The effects of a nonuniform magnetic field on the plasma presheath are numerically investigated using the plasma equation for a collisionless plasma with a finite temperature particle source. The present calculation confirms that previously published analytical solutions are available over a wide range of mirror ratios. Potential drop in the presheath, which depends considerably on both the magnetic strength profile and the spatial distribution of the particle source, is remarkably increased by applying an expanding magnetic field when plasma particles are generated in the inner part of the plasma. An effect of a nonuniform magnetic field on sheath formation is also discussed by using the calculated ion distribution function. If the plasma equation has no singularity at the sheath edge, its solution satisfies the generalized Bohm criterion with the inequality sign in the expanding magnetic field. Author

N91-18844# National Inst. for Fusion Science, Nagoya (Japan).
ON RELATION BETWEEN LOCAL TRANSPORT COEFFICIENT AND GLOBAL CONFINEMENT SCALING LAW
Kimitaka Itoh and Sanae-I. Itoh Jan. 1991 23 p
(NIFS-68; ISSN-0915-633X) Avail: NTIS HC/MF A03

The relation between the local thermal transport coefficient and the scaling laws of the global energy confinement time is discussed. It is found that the parameter dependence of the scaling law is modified strongly by the density profile and is often dictated by the transport coefficient near the plasma boundary. When the plasma has a steep gradient near the edge, the effect is enhanced. The representation of the empirical scaling law by the averaged quantities of the plasma could be misleading in this respect. Author

N91-18845# Los Alamos National Lab., NM.
ZTI: PRELIMINARY CHARACTERIZATION OF AN IGNITION CLASS REVERSED-FIELD PINCH
C. G. Bathke, R. A. Krakowski, R. L. Miller, and K. A. Werley 1990 8 p Presented at the 9th Topical Meeting on Technology of Fusion Energy, Oak Brook, 7-11 Oct. 1990
(Contract W-7405-eng-36)
(DE91-007353; LA-UR-91-23; CONF-901007-58) Avail: NTIS HC/MF A02

A preliminary cost-optimized conceptual design of an intermediate-step, ignition-class reverse-field pinch (RFP) device (ZTI) for the study of alpha-particle physics in a deuterium (DT) plasma is reported. The ZTI design reflects potentially significant cost savings relative to similar ignition-class tokamaks for device parameters that reside on the path to a viable commercial RFP reactor. Reductions in both device costs and number of steps to commercialization portend a significantly reduced development cost for fusion. The methodology and result and coupling realistic physics, engineering, and cost models through a multi-dimensional optimizer are reported for ZTI, which is a device that would follow the 2 to 4 MAzth on an approximately greater than 1996 to 98 timescale. DOE

N91-18846# Los Alamos National Lab., NM.
ADAPTIVE GRIDS AND IMPLICIT DIFFERENCING APPLIED TO PLASMA SIMULATION
J. U. Brackbill, D. W. Forslund, and Hoanh Vu 1990 5 p Presented at the US-Japan Workshop on Advances in Simulation Techniques Applied To Plasmas and Fusion, Los Angeles, 26-28 Sep. 1990
(Contract W-7405-eng-36)
(DE91-007383; LA-UR-91-103; CONF-9009269-6) Avail: NTIS HC/MF A01

To understand the kinetic processes that determine energy confinement and impurity production in magnetic confinement experiments, methods were developed to model kinetic effects on magnetohydrodynamic time scales in realistic geometries. Implicit methods and adaptive grids were used to achieve this goal. DOE

N91-18847# Wisconsin Univ., Madison. Dept. of Physics.
MODIFIED POLYNOMIAL FUNCTION MODEL FOR REVERSED FIELD PINCHES
W. Shen and J. C. Sprott Nov. 1990 31 p
(Contract DE-FG02-85ER-53198)
(DE91-007662; DOE/ER-53198/166) Avail: NTIS HC/MF A03

A generalized analytic representation for the magnetic field and current density profiles in a reversed field pinch (RFP) is proposed. These profiles have zero current density at the wall and finite plasma pressure. The profiles are characterized by two free parameters here taken to be the field reversal parameter (F) and pinch parameter (Theta). From the profiles, many useful quantities such as magnetic energy, beta, inductance, resistance and ohmic input power are calculated. These quantities provide a basis for analyzing experimental data and performing electrical circuit modeling of RFP discharges. DOE

N91-18973*# Mississippi State Univ., Mississippi State. Dept. of Mechanical and Nuclear Engineering.
WELDING ARC PLASMA PHYSICS
Bruce L. Cain *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20I

N91-19009*# Florida International Univ., Miami. Dept. of Physics.
HIGH VOLTAGE PLASMA SHEATH ANALYSIS RELATED TO TSS-1
John W. Sheldon *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N91-18848# Lawrence Livermore National Lab., CA. Condensed Matter Div.
A COMPARATIVE STUDY OF SHORT RANGE ORDER IN Fe-Cr AND Fe-V ALLOYS AROUND EQUIATOMIC COMPOSITION
P. E. A. Turchi, M. Sluiter, and G. M. Stocks (Oak Ridge National Lab., TN.) Dec. 1990 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26 Nov. - 1 Dec. 1990 Submitted for publication
(Contracts W-7405-eng-48; DE-AC05-84OR-21400)
(DE91-005230; UCRL-JC-104590; CONF-901105-39) Avail: NTIS HC/MF A02

Configurational energies have been calculated for equiatomic Fe-Cr and Fe-V alloys possessing the high temperature bcc crystalline structure, within a first principles electronic band structure approach. In agreement with experimental facts, a tendency towards order, with a B2 ordered structure of CsCl type, is found for FeV whereas phase separation characterized FeCr. These results suggest that the nature of short range order in the high temperature bcc solid solution is not the primary driving force for describing the structural transformation from bcc to sigma which takes place in both alloys upon decreasing temperature. DOE

N91-18849# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
SINTERING BEHAVIOR OF DOPED ZnO POWDERS FOR HIGH FIELD VARISTORS M.S. Thesis
Massimiliano Ghirlanda Aug. 1990 71 p Sponsored by Sandia National Lab. Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE91-005233; LBL-29736) Avail: NTIS HC/MF A04

The sintering of ZnO varistor precursor powders, doped with Co, Mn and different concentrations of Bi and Al, is investigated and discussed in relation with sintering models. One purpose of the present study is to provide information valuable for the fabrication of high field varistors. As the fundamental parameter of these electronic components is the breakdown voltage per unit of thickness, which is determined by the number of grain boundaries per linear dimension, the grain size and the sintered density are crucial variables, and the sintering is a central step in the manufacturing of such varistors. Sintering experiments performed at constant heating rate in a loading dilatometer provide data on the densification and creep of the compacted powders. Another goal of the present study is to provide an experimental basis for the interpretation of the evolution of the ratio between densification rate and creep rate in terms of competition between densification and microstructure coarsening. This is accomplished by taking advantage of the variety of sintering behaviors that takes place in the system ZnO-Bi-Al: the comparison of these behaviors allows us to correlate the macroscopic sintering parameters to the evolution of the microstructure. It results that, while in non-doped powders densification and coarsening develop in a balanced way, resulting in the constancy of the ratio between densification rate and creep rate, the effect of the dopants on the sintering kinetics alters such a balance, leading this ratio to vary. DOE

N91-18850# California Univ., Berkeley. Lawrence Berkeley Lab. Materials Sciences Div.
HYDROGEN IN SEMICONDUCTORS
Eugene E. Haller Jun. 1990 13 p Presented at the 20th International Union of Pure and Applied Physics of Semiconductors Thessaloniki, Greece, 6-10 Aug. 1990 Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098; NSF DMR-88-06756)
(DE91-005292; LBL-28691; CONF-900866-1) Avail: NTIS HC/MF A03

After an 'incubation' period in the 1970s and early 1980s, during which the first hydrogen related centers were discovered and characterized in ultra-pure germanium, a sharp increase of research activity occurred after the discovery of shallow acceptor passivation in crystalline silicon. The aim of this review is to convey an insight into the rich, multifaceted physics and materials science which has emerged from the vast variety of experimental and theoretical studies of hydrogen in semiconductors. In order to arrive at the current understanding of hydrogen related phenomena in a logical way, each chapter will start with a brief review of the major experimental and theoretical advances of the past few years. Those who are interested to learn more about this fascinating area of semiconductor research are referred to reviews, to a number of conference proceedings volumes, and to an upcoming book which will contain authoritative chapters on most aspects of hydrogen in crystalline semiconductors. Some of the early art of semiconductor device processing can finally be put on a scientific foundation and new ways of arriving at advanced device structures begin to use what we have learned from the basic studies of hydrogen in semiconductors. DOE

N91-18851# Oak Ridge National Lab., TN. Metals and Ceramics Div.
IN-SITU OBSERVATIONS OF HIGH TEMPERATURE SURFACE PROCESSES ON ALPHA-ALUMINA BULK CRYSTALS
Z. L. Wang (Tennessee Univ., Knoxville.) and J. Bentley 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005509; CONF-901105-47) Avail: NTIS HC/MF A02

Reflection electron microscopy (REM) was applied to image in situ the dynamic changes of atomic-height steps on the surfaces of alpha-alumina bulk crystals heated to high temperatures. Atomic diffusion, desorption and adsorption processes on cleaved alpha-alumina (012) surfaces were directly observed at temperatures of 1470 to 1670 K. The surface started to show visible structural changes at 1470 to 1520 K. The main surface process appears to be atomic desorption, which creates large, flat vacancy-type terraces on the surface. DOE

N91-18852# Los Alamos National Lab., NM.
CUBIC NEW COMPOUND IN THE Ba-Ca-Cu-O SYSTEM: PRELIMINARY PHASE RELATIONSHIPS
K. A. Kubat-Martin, D. E. Peterson, G. H. Kwei, E. Garcia, and R. H. Wolverton (Air Force Academy, CO.) 1990 8 p Presented at the American Ceramic Society's Electronics Division Meeting, Orlando, FL, 12-15 Nov. 1990
(Contract W-7405-eng-36)
(DE91-005880; LA-UR-90-4223; CONF-901114-1) Avail: NTIS HC/MF A02

A new compound was identified in the Ba-Ca-Cu-O phase diagram with a composition close to Ba4CaCu3O(x). Single crystal x ray diffraction reveals that is phase crystallizes in an ordered

cell based on a cubic perovskite framework, but with doubled unit cell constants. The compound, which is not superconducting, was also characterized via powder x ray and neutron diffraction. In addition, some preliminary tie line relationships are reported to and near Ba4CaCu3O(x) in the Ba-Ca-Cu-O phase diagram and reactions of Ba4CaCu3O(x) with TI2O3. DOE

N91-18853# Los Alamos National Lab., NM. Exploratory Research and Development Center.
SPECIFIC HEAT OF YBa2Cu4O8 NEAR Tc
J. O. Willis, Izumi Tomeno, Takayuki Miyatake, Takao Itoh, Keishi Tai, Naoki Koshizuka, and Shoji Tanaka (International Superconductivity Technology Center, Tokyo, Japan) 1990 5 p Presented at the 3rd International Symposium on Superconductivity, Sendai, Japan, 6-9 Nov. 1990 Submitted for publication Sponsored by New Energy and Industrial Technology Development Organization, Tokyo, Japan
(Contract W-7405-eng-36)
(DE91-005898; LA-UR-90-4157; CONF-901169-4) Avail: NTIS HC/MF A01

Specific heat measurements are reported for a polycrystalline, bulk sample of YBa2Cu4O8 prepared at high oxygen pressure. The magnitude of the idealized specific heat jump difference C(sub p)/T at (Tc) (= 80 + or - 0.5 K) is 15.5 + or - 2 mJ/K(exp 2)-mole. The transition width difference (Tc) is about 3 K. The size of the jump is greatly reduced compared to YBa2Cu3O7. The normal state magnetic susceptibility is somewhat smaller than in YBa2Cu3O7 and is temperature dependent. The results suggest a smaller electronic density of states for YBa2Cu4O8. DOE

N91-18854# Los Alamos National Lab., NM.
THE GOLD/HIGH TEMPERATURE SUPERCONDUCTOR INTERFACE: METALLICITY OF THE NEAR SURFACE REGION AND A SEARCH FOR THE PROXIMITY EFFECT
D. S. Dessau, Z.-X. Shen, B. O. Wells, W. E. Spicer, R. S. List, A. J. Arko, R. J. Bartlett, Z. Fisk, S.-W. Cheong, and C. G. Olson (Ames Lab., IA.) et al 1990 21 p Presented at the 37th National American Vacuum Society Symposium, Toronto, Ontario, 8-12 Oct. 1990
(Contracts W-7405-eng-36; N00014-84-K-0327; NSF DMR-89-103478; DAAG29-85-K-0048)
(DE91-005950; LA-UR-90-4359; CONF-901035-14) Avail: NTIS HC/MF A03

High resolution photoemission spectroscopy was used to probe the electronic structure of a wide variety of gold/high temperature superconductor interfaces, the majority of which were formed by low temperature (20 K) gold evaporations on cleaved high quality single crystals. For c-axis interfaces formed on the 123 family of superconductors, it was found that the gold deposition essentially destroys the metallicity of the superconducting substrate in the near surface region (approx 5A), while the near surface region of Bi2Sr2CaCu2O8 remains metallic. Photoemission spectroscopy was also used to search for a proximity effect superconducting gap in gold overlayers on c-axis single crystals and a-axis thin films, though no such effect was found. DOE

N91-18855# Lawrence Livermore National Lab., CA.
TIME-DEPENDENT LIQUID METAL FLOWS WITH FREE CONVECTION AND FREE SURFACES
Matthew A. McClelland Nov. 1990 41 p Presented at the American Institute of Chemical Engineers Fall Annual Meeting, Chicago, IL, 11-16 Nov. 1990
(Contract W-7405-eng-48)
(DE91-004882; UCRL-100847-REV-1; CONF-901155-3-REV-1; AICHE-PAPER-174-E) Avail: NTIS HC/MF A03

A finite element analysis is given for time-dependent liquid metal flows with free convection and free surfaces. Consideration is given to a two-dimensional shallow trough with vertical walls maintained at different temperatures. The spatial formulation incorporates mixed Lagrangian approximations to the velocity, pressure, temperature, and interface position. The time integration method is performed using the Trapezoid Rule with step-size control. The Galerkin method is employed to reduce the problem to a set of nonlinear algebraic equations which are solved with the Newton-Raphson method. Calculations are performed for conditions relevant to the electron beam vaporization of refractory metals. The Prandtl number is 0.015, and Grashof numbers are in the transition region between laminar and turbulent flow. The results reveal the effects of flow intensity, surface-tension gradients, and mesh and time-step refinement. DOE

N91-18856# Oak Ridge National Lab., TN.
THE STABILITY OF IRRADIATION-INDUCED DEFECTS IN NI3AI
D. F. Pedraza, A. Caro, and D. Farkas (Virginia Polytechnic Inst. and State Univ., Blacksburg.) 1990 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990 Submitted for publication Sponsored in part by National Energie-Forschung-Fonds; and by Fonds National Suisse de la Recherche Scientifique
(Contract DE-AC05-84OR-21400)
(DE91-005514; CONF-901105-46) Avail: NTIS HC/MF A02

The L1 sub 2 Ni3Al compound is known to be disordered by ion or electron irradiation, while preserving its crystalline structure. In this work, embedded-atom potentials are used to investigate the change of internal energy of the crystal and of the lattice parameter as a function of the degree of long range order. Various vacancy-interstitial configurations are investigated in order to explore the possibility of substantial point defect buildup. It is found that spontaneous recombination is a function of the nature of the interstitial, the vacancy-interstitial distance and the characteristics of the atomic environment of the pair. The vacancy-interstitial interaction is also found to be, in some cases, dependent on the local atomic environment. Local disorder, moreover, can produce in some cases interstitial trapping. The implications of the effects obtained in the present simulations on the possibility of an irradiation-induced amorphous transition are discussed. DOE

N91-18857# Argonne National Lab., IL. Engineering Physics Dept.
MEASUREMENTS OF THE RF SURFACE RESISTANCE OF HIGH-Tc SUPERCONDUCTORS
J. R. Delayen, C. L. Bohn, and C. T. Roche 1990 4 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990 Sponsored in part by Army
(Contract W-31-109-eng-38)
(DE91-006554; CONF-900944-30) Avail: NTIS HC/MF A01

An experimental program is being conducted to assess the applicability of high-(Tc) superconductors for use in high power RF and microwave devices. The program involves the measurement of the RF surface resistance of high-(Tc) samples at frequencies between 0.15 and 40 GHz and RF surface magnetic fields as high as 640 gauss. Polycrystalline samples were found to have surface resistances which increase monotonically with RF-field amplitude, saturating at high field at a few percent of the normal-state surface resistance just above (Tc). DOE

N91-18858# Argonne National Lab., IL.
SILVER SHEATHING OF HIGH-Tc SUPERCONDUCTOR WIRES
C. T. Wu, G. A. Risch, R. B. Poeppel, K. C. Goretta, S. Danyluk, and H. M. Herro (Nalco Chemical Co., Naperville, IL.) Oct. 1990 13 p Presented at the 2nd World Congress on Superconductivity, Houston, TX, 10-13 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-006557; CONF-900910-1) Avail: NTIS HC/MF A03

The properties of Ag sheaths on high-temperature super-conductors are examined. Ag is chemically compatible with YBa2Cu3O(x) and Bi-based superconductors can be safely coprocessed with them. Residual stresses created by differences in thermal expansion coefficients are favorable and can be controlled by proper annealing. Although Ag forms low-resistance contact with high temperature superconductors, it is not certain that effective cryogenic stabilization by Ag can occur at 77 K and above. DOE

N91-18859# Pacific Northwest Lab., Richland, WA.
KEY STRUCTURE-ACTIVITY RELATIONSHIPS IN THE VANADIUM PHOSPHORUS OXIDE CATALYST SYSTEM
Michael R. Thompson and Jerry R. Ebner (Monsanto Co., Saint Louis, MO.) Apr. 1990 13 p Presented at the 1990 National Meeting of the American Chemical Society, Boston, MA, 22-27 Apr. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005247; PNL-SA-17971; CONF-9004254-1) Avail: NTIS HC/MF A03

The crystal structure of vanadyl pyrophosphate has been redetermined using single crystals obtained from a near solidified melt of a microcrystalline catalyst sample. Crystals that index as vanadyl pyrophosphate obtained from this melt are variable in color. Crystallographic refinement of the single crystal x-ray diffraction data indicates that structural differences among these materials can be described in terms of crystal defects associated with linear disorder of the vanadium atoms. The importance of the disorder is outlined in the context of its effect on the proposed surface topology parallel to (1,0,0). Models of the surface topology simply and intuitively account for the non-stoichometric surface atomic P/V ratio exhibited by selective catalysts of this phase. These models also point to the possible role of the excess phosphorus in providing site isolation of reactive centers at the surface. DOE

N91-18860# California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
HVEM (HIGH VOLTAGE ELECTRON MICROSCOPY) STUDIES OF THE SINTERING OF MgO NANOCRYSTALS PREPARED BY Mg(OH)2 DECOMPOSITION
N. Thangaraj, K. H. Westmacott, and U. Dahmen May 1990 26 p Presented at the International Conference on Frontiers of Electron Microscopy, Oak Brook, IL, 21-24 May 1990 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE91-005403; LBL-28653; CONF-9005145-4) Avail: NTIS HC/MF A03

Hot-stage high voltage electron microscopy (HVEM) combined with high resolution electron microscopy (HREM) has been employed to study the microstructural evolution during in-situ decomposition of thin Mg(OH)2 flakes and during early stage sintering of the resultant nanocomposite. The decomposition reaction is known to be pseudomorphic and topotactic, resulting in a regular composite of highly nearly cubic MgO nanocrystals interspersed with a roughly equal volume of pores. This structures was characterized by selected area and optical diffraction techniques as well as by HREM, depending on its microstructural scale. Immediately after decomposition and in the early stages of sintering the fine scale and regular, nearly periodic nature of the microstructure gave rise to diffuse small angle diffraction rings that could be used as a measure of coarsening during in-situ heating in the temperature range 350 to 900 C. Consistent result were obtained from electron diffraction, optical diffraction and Fourier transforms of digitized images. These measurements were complementary of direct imaging by HREM or conventional imaging techniques. DOE

N91-18861# Los Alamos National Lab., NM.
SHOCK-WAVE EQUATION-OF-STATE STUDIES AT LOS ALAMOS
Charles E. Morris 1990 14 p Presented at the Shock Symposium, Tokyo, Japan, 11-12 Dec. 1990
(Contract W-7405-eng-36)
(DE91-005734; LA-UR-90-4208; CONF-901267-1) Avail: NTIS HC/MF A03

A history of the shock-wave equation-of-state (EOS) studies at Los Alamos is given. Particular emphasis is placed on the pioneering research in the 1950s where many of the experimental techniques and methods of analysis were developed, which we now take for granted. A brief review of shock-wave physics is given, which illustrates important hydrodynamic and thermodynamic concepts. Recent studies on the EOS of Ti are presented with emphasis on the alpha-to-omega phase transition. VISAR wave profiles on polycrystalline Ni and single-crystal Ni are presented to determine the strengths of these materials at pressure. Low-density polystyrene foam Hugoniot experiments are described and results analyzed. DOE

N91-18862# Oak Ridge National Lab., TN.
NEUTRON SCATTERING STUDIES OF THE HIGH-TEMPERATURE SUPERCONDUCTING MATERIALS Foreign Trip Report
H. A. Mook, Jr. Jan. 1991 8 p
(Contract DE-AC05-84OR-21400)
(DE91-006016; ORNL/FTR-3859) Avail: NTIS HC/MF A02

The traveler was given beam time at the ILL to continue neutron scattering work on high-temperature superconductivity. The unique facilities at the ILL for both high-energy and low-energy neutron instrumentation made the experiments possible. The measurements consisted of two basic types. The first of these is the study of the nature of spin fluctuations in high-(Tc) materials. This work is fundamental to the mechanism that is responsible for the high-transition temperatures. The second consisted of experiments on the flux lattice in high-temperature superconductors. The flux lattice has interesting physics in its own right and is important in understanding the current-carrying capability of superconductors. DOE

N91-18863# Oak Ridge National Lab., TN. Solid State Div.
HIGH-SPEED EPITAXY USING SUPERSONIC MOLECULAR JETS
Djula Eres 1990 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE91-006155; CONF-901105-59) Avail: NTIS HC/MF A02

The use of supersonic jets of gaseous source molecules in thin films growth is discussed. Molecular jets in free form with no skimmers or collimators in the nozzle-substrate path were used in the investigation of basic film growth processes and in practical film growth applications. The Ge growth rates were found to depend linearly on the digermane jet intensity. Furthermore, the film thickness distributions showed excellent agreement with the distribution of digermane molecules in the jet. High epitaxial Ge growth rates were achieved on GaAs (100) substrates by utilizing high-intensity pulsed jets. The practical advantages and limitations of this film growth technique are evaluated, based on the results of microstructural and electrical measurements of heteroepitaxial Ge films on GaAs (100) substrates. DOE

N91-18864# Clemson Univ., SC. Chemistry Lab.
INTRAMOLECULAR ENERGY TRANSFER REACTIONS IN POLYMETALLIC Progress Report, Jul. 1989 - Nov. 1989
John D. Petersen Nov. 1990 33 p
(Contract DE-FG09-87ER-13768)
(DE91-006391; DOE/ER-13768/2) Avail: NTIS HC/MF A03

This report is concerned with intramolecular, energy-transfer reactions. The concept of synthetically preparing a complex molecular species capable of absorbing a photon at one metal center (antenna fragment) then transferring that energy to a second metal center (reactive fragment) via a bridging ligand was first reported by our group in 1979. It is now apparent that a major emphasis in inorganic chemistry in the future will involve these types of molecular ensembles. Complexes discussed include Rh, Ru, and Cu complexes. DOE

N91-18865*# Argonne National Lab., IL. Materials Science Div.
INTERACTIONS OF ENERGETIC PARTICLES AND CLUSTERS WITH SOLIDS
R. S. Averback, Horngming Hsieh, T. DiazdelaRubia (Lawrence Livermore National Lab., CA.), and R. Benedek Dec. 1990 22 p Presented at the 7th International Conference on Ion Beam Modification of Materials, Knoxville, TN, 10-14 Sep. 1990 Sponsored by NASA, Ames Research Center

(Contracts W-31-109-eng-38; DE-AC02-76ER-01198)
(NASA-CR-188000; NAS 1.26:188000; DE91-006584;
CONF-900936-26) Avail: NTIS HC/MF A03 CSCL 20L

Ion beams are being applied for surface modifications of materials in a variety of different ways: ion implantation, ion beam mixing, sputtering, and particle or cluster beam-assisted deposition. Fundamental to all of these processes is the deposition of a large amount of energy, generally some keV's, in a localized area. This can lead to the production of defects, atomic mixing, disordering and in some cases, amorphization. Recent results of molecular dynamics computer simulations of energetic displacement cascades in Cu and Ni with energies up to 5 keV suggest that thermal spikes play an important role in these processes. Specifically, it will be shown that many aspects of defect production, atomic mixing and cascade collapse can be understood as a consequence of local melting of the cascade core. Included in this discussion will be the possible role of electron-phonon coupling in thermal spike dynamics. The interaction of energetic clusters of atoms with solid surfaces has also been studied by molecular dynamics simulations. this process is of interest because a large amount of energy can be deposited in a small region and possibly without creating point defects in the substrate or implanting cluster atoms. The simulations reveal that the dynamics of the collision process are strongly dependent on cluster size and energy. Different regimes where defect production, local melting and plastic flow dominate will be discussed. DOE

N91-18866# Argonne National Lab., IL.
THERMODYNAMIC BEHAVIOR OF HIGH-Tc OXIDE SYSTEMS VIA EMF AND RELATED MEASUREMENTS
M. Tetenbaum, P. Tumidajaski, I. D. Bloom, D. L. Brown, and M. Blander 1991 23 p Presented at the 6th International School on Condensed Matter Physics: New Physical Problems in Electronic Materials, Varna, Bulgaria, 21-29 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-006590; CONF-9009330-1) Avail: NTIS HC/MF A03

EMF measurements of oxygen fugacities as a function of stoichiometry have been made in the YBa2Cu3O(x), NdBa-2Cu3O(x), and Nd(1.81)Ce(0.19)CuO(x) superconducting systems in temperature range 400 to 750 C by means of an oxygen titration technique with an yttria-stabilized zirconia electrolyte. The object of our current measurements is to investigate the effect of ionic size of Y, Gd and Nd on the thermodynamic behavior and structural transition in the LnBa2Cu3O(x) system. The shape of the 400 C isotherm for NdBa2Cu3O(x) suggests the presence of a miscibility gap at lower temperatures, at values of x that are higher than those in the YBa2Cu3O(x) system. The locations of the miscibility gaps are consistent with the effects of ionic radii on the composition dependence of T(sub c) for these systems. Our results explain the two plateaus in measured values of T(sub c) as a function of composition for the YBa2Cu3O(x) system and appear to be consistent with the less pronounced T(sub c) plateaus found for the NdBa2Cu3O(x) system higher stoichiometry values. For a given oxygen stoichiometry, partial pressures of oxygen above NdBa2Cu3O(x) are higher than for the YBa2Cu3O(x) system in accord with calculated partial molar thermodynamic quantities. The results of limited measurements on the n-type (electron-doped) superconducting Nd(1.81)Ce(0.19)-CuO(x) system will be presented. A thermodynamic assessment and intercomparison of our oxygen partial pressure measurements with the results of other measurements will be presented. DOE

N91-18867# Argonne National Lab., IL.
PREPARATION AND PROPERTIES OF Y-124 SUPERCONDUCTOR MADE BY A CHEMICAL PRECIPITATION METHOD
Henry L. Laquer, J. R. Gaines, Jr., Scott Brainard, Scott D. Hutson (Superconductive Components, Inc., Columbus, OH.), Julie Pisanelli, D. W. Cooke, E. R. Gray, Kevin C. Ott, Eric J. Peterson, and J. F. Smith 1990 6 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990
Submitted for publication
(Contract W-31-109-eng-38)
(DE91-006592; CONF-900944-37) Avail: NTIS HC/MF A02

The thermodynamically stable YBCO-124 high temperature superconductor was prepared in powder form by a chemical precipitation method and the material was characterized by a number of chemical and physical methods, including carbon content, x ray diffraction, thermogravimetry, scanning electron microscopy, surface area, thermally stimulated luminescence, and the superconducting transition and magnetization curves. The powders by hot pressing were consolidated. DOE

N91-18868# Argonne National Lab., IL. Engineering Physics Div.
HIGH ELECTRIC FIELDS IN A SUPERCONDUCTING RFQ STRUCTURE
J. R. Delayen and K. W. Shepard 24 Sep. 1990 4 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-006593; CONF-900944-38) Avail: NTIS HC/MF A01

High surface electric fields have been obtained in the first tests of a superconducting RF quadrupole device. The RF quadrupole fields were generated between niobium vanes 6.5 cm in length, with an edge radius of 2 mm, and with a beam aperture of 6 mm diameter. In tests at 4.2 K, the 64 MHz device operated CW at peak surface electric fields of 128 MV/m. Virtually no electron loading was observed at fields below 100 MV/m. It was possible to operate at surface fields of 210 MV/m in pulses of 1 msec duration using a 2.5 kW RF source. For the vane geometry tested, more than 10 square centimeters of surface support a field greater than 90 percent of the peak field. The present result indicates that electric fields greater than 100 MV/m can be obtained over an appreciable area, sufficient for some accelerator applications. It also shows that superconducting RF technology may provide an extended range of options for RF quadrupole design. DOE

N91-18869# Oak Ridge National Lab., TN. Solid State Div.
SPUTTER DEPOSITION OF LITHIUM SILICATE-LITHIUM PHOSPHATE AMORPHOUS ELECTROLYTES
N. J. Dudney, J. B. Bates, C. F. Luck, and J. D. Robertson (Kentucky Univ., Lexington.) Jan. 1991 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE91-006603; CONF-901105-78) Avail: NTIS HC/MF A02

Thin films of an amorphous lithium-conducting electrolyte were deposited by RF magnetron sputtering of ceramic targets containing Li4SiO4 and Li3PO4. The lithium content of the films was found to depend more strongly on the nature and composition of the targets than on many other sputtering parameters. For targets containing Li4SiO4, most of the lithium was found to segregate away from the sputtered area of the target. Codeposition using two sputter sources achieves a high lithium content in a controlled and reproducible film growth. DOE

N91-18870# Argonne National Lab., IL.
TEXTURE CHARACTERIZATION OF HIGH Tc THICK FILMS
A. C. Biondo, J. S. Kallend, R. B. Poeppel, M. T. Lanagan, and T. C. Schofield (Los Alamos National Lab., NM.) Jun. 1990 8 p Presented at the 23rd International Symposium on Microelectronics (ISHM 90), Chicago, IL, 13-17 Oct. 1990
(Contracts W-31-109-eng-38; W-7405-eng-36)
(DE91-006652; CONF-9010303-1) Avail: NTIS HC/MF A02

The anisotropic properties which exist in all high Tc compounds make it necessary to characterize the preferred orientation (or texture) of crystals which results from various processing methods. Once a suitable preferred orientation is achieved, a significant increase in performance is anticipated. Thick films (approx. 80 microns) of Bi-Sr-Ca-Cu-O (BSCCO) on silver substrates were characterized by pole figure techniques to obtain an Orientation Distribution Function (ODF). DOE

N91-18871# Ames Lab., IA.
VISCOUS FLUX MOTION IN ANISOTROPIC TYPE-2 SUPERCONDUCTORS IN LOW FIELDS
Zhidong Hao and J. R. Clem 1990 4 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990 Prepared in cooperation with Iowa State Univ. of Science and Technology, Ames
(Contract W-7405-eng-82)
(DE91-006675; IS-M-655; CONF-900944-33) Avail: NTIS HC/MF A01

The Bardeen-Stephen model of viscous flux motion in isotropic Type-II superconductors is extended to the anisotropic case characterized by a phenomenological effective mass tensor m(sub ij). When the magnetic field is low and the vortex lines are aligned along one of the three principal axes, simple expressions for the viscosity tensor (eta)(sub ij) of the viscous flux motion are obtained as functions of m(sub ij) and the normal state conductivity tensor (sigma)(sub ij) for temperature T close to the critical temperature (Tc). For the high-temperature oxide superconductors the theory predicts that eta sub b sup a: eta sub b sup c: eta sub c sup a approx 1:4 gamma: 3 gamma sup 2, where eta sub i sup j is the viscosity for the motion along the i-axis of a vortex parallel to the j-axis and gamma = radical m sub c/m sub a is the anisotropy parameter m sub i, i = a,b,c, are the principal values of the mass tensor satisfying m sub a approx m sub b (much lt) m sub c. DOE

N91-18872# Sandia National Labs., Albuquerque, NM.
THE PREPARATION OF InAsSb/InSb SLS (STRAINED-LAYER SUPERLATTICE) AND InSb PHOTODIODES BY MOCVD
R. M. Biefeld, B. T. Cunningham, S. R. Kurtz, and J. R. Wendt 1990 5 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC04-76DP-00789)
(DE91-006781; SAND-90-3200C; CONF-901105-81) Avail: NTIS HC/MF A01

Infrared absorption and photoluminescence have been demonstrated for InAs(1-x)Sb(x)/InSb strained-layer superlattices (SLS's) in the 8 to 15 microns region for As content less than 20 percent. This extended infrared activity is due to the type II heterojunction band offset in these SLS's. The preparation of the first MOCVD grown p-n junction diode was achieved by using dimethyltellurium as an in-type dopant. Several factors, such as background doping and dopant profiles affect the performance of this device. InSb diodes have been prepared using tetraethyltin. The resulting current-voltage characteristics are improved over those of diodes grown previously using dimethyltellurium. Doping levels of 8 x 10(exp 15) to 5 x 10(exp 18) per cu cm and mobilities of 6.7 x 10(exp 4) to 1.1 x 10(exp 4) sq cm/Vs have been measured for Sn doped InSb. SLS diode structures have been prepared using Sn and Cd as the dopants. Structures prepared with p-type buffer layers are more reproducible. DOE

N91-18873# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Metallurgical Engineering and Materials Science.
THE ROLE OF MICROSTRUCTURAL PHENOMENA IN MAGNETIC THIN FILMS
David E. Laughlin and David N. Lambeth 1990 7 p
(Contract DE-FG02-90ER-45423)
(DE91-006797; DOE/ER-45423/1) Avail: NTIS HC/MF A02

This progress report discusses two areas of research, namely the sputtering of Co-Ni-Cr films onto single crystal underlayers and the production of Co-Sm thin films with high coercivity. Included are a listing of papers submitted for publication, proposed research for year 2 (August 1991 to July 1992), and the year 2 budget. DOE

N91-18874# Delaware Univ., Newark. Inst. of Energy Conversion.
FUNDAMENTALS OF POLYCRYSTALLINE THIN FILM MATERIALS AND DEVICES Final Subcontract Report, 1 Jan. 1989 - 15 Jan. 1990
Bill N. Baron, Robert W. Birkmire, James E. Phillips, William N. Shafarman, Steven S. Hegedus, and Brian E. McCandless Jan. 1991 98 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE91-002130; SERI/TP-211-4133) Avail: NTIS HC/MF A05

This report presents the results of a one-year research program on polycrystalline thin-film solar cells. The research was conducted to better understand the limitations and potential of solar cells using CuInSe2 and CdTe by systematically investigating the fundamental relationships linking material processing, material properties, and device behavior. By selenizing Cu and In layers, we fabricated device-quality CuInSe2 thin films and demonstrated a CuInSe2 solar cell with 7 percent efficiency. We added Ga, to increase the band gap of CuInSe2 devices to increase the open-circuit voltage to 0.55 V. We fabricated and analyzed CuInGaSe2/CuInSe2 devices to demonstrate the potential for combining the benefits of higher V(sub oc) while retaining the current-generating capacity of CuInSe2. We fabricated an innovative superstrate device design with more than 5 percent efficiency, as well as a bifacial spectral-response technique for determining the electron diffusion length and optical absorption coefficient of CuInSe2 in an operational cell. The diffusion length was found to be greater than 1 micron. We qualitatively modeled the effect of reducing heat treatments in hydrogen and oxidizing treatments in air on the I-V behavior of CuInSe2 devices. We also investigated post-deposition heat treatments and chemical processing and used them to fabricate a 9.6 percent-efficient CdTe/CdS solar cell using physical vapor deposition. DOE

N91-18875# Rensselaer Polytechnic Inst., Troy, NY.
MICROCOMPUTER ENHANCED OPTICAL INVESTIGATION OF SPREADING AND EVAPORATIVE PROCESSES IN ULTRA THIN FILMS Progress Report, 1 Feb. - 31 Dec. 1990
P. C. Wayner, Jr., M. Sujanani, and A. H. Liu Dec. 1990 8 p
(Contract DE-FG02-89ER-14045)
(DE91-005592; DOE/ER-14045/2) Avail: NTIS HC/MF A02

The general objective is to determine the heat transfer characteristics of evaporating ultra-thin films. The immediate objective is to develop microscopic image-processing system (IPS) to measure the film thickness profile. The IPS has two parts: an image analyzing interferometer (IAI) and an image analyzing ellipsometer (IAE). An IAI was designed and used to measure the thickness profiles of an extended meniscus in the contact line region of a completely wetting film of Octane on an inclined, flat plate. The equilibrium profile agreed with theoretical predictions of the width of transition region, the curvature, and the thickness of the adsorbed film. The effect of transport processes on the thickness profile agreed with previous theoretical models. We find that the convenience and efficiency of microcomputer enhanced video microscopy naturally leads to a better understanding of the transport processes in the contact line region. We also find that the processes of change-of-phase heat transfer and fluid flow in thin films are intrinsically connected because of their common dependence on the intermolecular force field and gravity. The redesign of an image analyzing ellipsometer (IAE) has been completed and the system is being built and evaluated. DOE

N91-18876# Lawrence Livermore National Lab., CA.
DEFECT DEPENDENCE OF POSITRON LIFETIMES IN OXIDE SUPERCONDUCTORS
P. A. Sterne, J. C. OBrien, R. H. Howell, and J. H. Kaiser (Texas Univ., Arlington.) Nov. 1990 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 26-30 Nov. 1990 Submitted for publication Sponsored in part by Welch (Robert A.) Foundation
(Contract W-7405-eng-48)
(DE91-006714; UCRL-JC-104595; CONF-901105-83) Avail: NTIS HC/MF A02

First principles calculations of the positron lifetimes are used to interpret experimental lifetime data for Ba(sub 1-x)K(sub x)BiO(sub 3). The observed lifetimes are found to be very sensitive to the presence of defects in the sample. The temperature dependence of the lifetime and the change in lifetime with sample

aging are both attributed to defects. The qualitative differences between metal vacancy defects and oxygen vacancy defects in metal oxides are also discussed. DOE

N91-18877# Sandia National Labs., Albuquerque, NM.
SUPERCONDUCTING DEMODULATORS, DIFFERENTIAL VOLTMETERS, AND TRANSDUCERS
Robert V. Duncan 1991 4 p Presented at the 8th Oregon Conference on LT Physics, Washington, DC, 14-16 Jan. 1991
(Contract DE-AC04-76DP-00789)
(DE91-006773; SAND-90-3224C; CONF-910170-1) Avail: NTIS HC/MF A01

The capabilities of new superconducting measurement devices are reviewed and new applications of this technology are suggested. Specific ways in which these devices may enhance low temperature research in an orbiting laboratory are discussed. DOE

N91-18878# Maine Univ., Orono.
STRUCTURE, ADHESION, AND STABILITY OF METAL/OXIDE AND OXIDE/OXIDE INTERFACES Technical Progress Report, 1 Aug. 1990 - 31 Jul. 1991
R. J. Lad Jan. 1991 12 p
(Contract DE-FG02-90ER-45417)
(DE91-006981; DOE/ER-45417/1) Avail: NTIS HC/MF A03

During the past six months, the studies were begun of the fundamental properties of metal/oxide and oxide/oxide heterogeneous interfaces which are being prepared by epitaxial growth of ultra thin films on single crystal TiO2 and NiO surfaces. A new ultra high vacuum film growth chamber was assembled and coupled to an existing surface analysis chamber; a sample transfer system, metal deposition sources, and a RHEED systems with microchannel plate detection were constructed and implemented. Atomic Force Microscopy was used to characterize and refine the preparation procedures for the single crystal surfaces. The electronic structure of stoichiometric, oxygen deficient, and potassium-covered TiO2 (110) surfaces was investigated. Preliminary results on the Al/TiO2 (110) system were obtained. DOE

N91-18879# Lawrence Livermore National Lab., CA.
GRADED Al(x)Ga(1-x)As PHOTOCONDUCTIVE DEVICES FOR HIGH EFFICIENCY PICOSECOND OPTOELECTRONIC SWITCHING
John D. Morse, Raymond P. Mariella, and Robert W. Dutton (Stanford Univ., CA.) Oct. 1990 7 p Presented at the OPTCON 1990: SPIE Symposium on Laser Science and Applications of Optics, Boston, MA, 4-9 Nov. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-007143; UCRL-JC-103527; CONF-9011125-6) Avail: NTIS HC/MF A02

Picosecond photoconductivity has been achieved for a variety of semiconductor materials by techniques which have now become almost standard. Enhanced scattering by the excessive amount of deep level defects which provide for picosecond recombination lifetimes significantly reduce the mobility, degrading the responsivity of the photoconductor. A concept is presented where improved responsivity is achievable by utilizing a graded bandgap Al(x)Ga(1-x)As active detecting layer grown on a high defect density GaAs layer by molecular beam epitaxy (MBE). DOE

N91-18880# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
DEVELOPMENT OF Nb3Sn ac SUPERCONDUCTOR, PART 1
S. Akita, T. Tanaka, Y. Kubota, K. Yasohama, H. Kobayashi, and T. Ogasawara May 1990 47 p In JAPANESE; ENGLISH summary
(DE91-742150; CRIE-T-89051) Avail: NTIS HC/MF A03

The development of Nb3Sn superconducting wire for ac service is described. Wires are manufactured by the internal diffusion method, that is, by embedding many Nb filaments into Cu matrix, by drawing them to predetermined diameter, by plating Sn on the outside and then by diffusing Sn into inner part of wires through heat treatment to form Nb3Sn. Critical current J(sub c) at 4.2 K and magnetic flux density of 2T was 10(exp 10) A/sq m at the diameter of 0.1 micron or more, indicating that this value is 1,000 times larger than that of Cu conductor. But finer filament of 0.05 micron resulted J(sub c) of 1/5 because the diffusion of Sn is not sufficient and the formed amount of Nb3Sn was fewer. When the internal diffusion method where Sn is embedded from the beginning into Cu/Nb composite wires, and drawing and heat treatment were carried out, J(sub c) increased two times or more. The ac loss of wire of 0.6 micron diameter was 10 kJ/cu m per cycle at magnetic field amplitude of 1T, that is, 40 percent of Cu conductor. The ac loss is three times higher than the theoretical value and much finer wires of circular cross section are required. DOE

N91-18881# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
SPECTROSCOPY OF EXCITATIONAL POLARITONS IN CdS. RELAXATION PROCESSES IN SPATIAL DISPERSIVE MEDIA Ph.D. Thesis [SPEKTROSKOPIE EXZITONISCHER POLARITONEN IN CDS. RELAXATIONSPROZESSE IN RAEUMLICH DISPERSIVEN MEDIEN]
Karl-Heinz Pantke 1990 177 p In GERMAN
(ETN-91-98780) Avail: NTIS HC/MF A09

Experimental Brillouin similar scattering processes were detailed and examined with phonons between the different modes. The attenuation of the measured transmission band edge short range caused by Brillouin similar scattering processes was discussed by means of dielectric functions of excitonal polaritons, which contain the phase ralaxation time, under the form of an attenuation parameter. The interaction of the solid body with all quasi particles was described. The systematic examination of the energy absorption takes place by means of excitation spectroscopy of deep lattice distortion luminescence and its line shape analyses. ESA

N91-18882# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
DEVELOP AND TEST AN INTERNALLY COOLED, CABLED SUPERCONDUCTOR (ICCS) FOR LARGE SCALE MHD MAGNETS
P. G. Marston, J. R. Hale, and A. M. Dawson 30 Apr. 1990 58 p
(Contract DE-AC22-84PC-70512)
(DE91-005536; DOE/PC-70512/16; PFC/RR-90-4) Avail: NTIS HC/MF A04

The work included four principal tasks: (1) development of a design requirements definition for a retrofit MHD magnet system; (2) analysis of an internally cooled, cabled superconductor (ICCS) to use in that design; (3) design of an experiment to test a subscale version of that conductor, which is a NbTi, copper stabilized superconductor; and (4) proof-of-concept testing of the conductor. The program was carried forth through the third task with very successful development and test of a conventional ICCS conductor with 27 multifilamentary copper-superconductor composite strands and a new concept conductor in which, in each triplet, two strands were pure copper and the third strand was a multifilamentary composite. In reviewing the magnet design and the premises for the conductor design it became obvious that an extra barrier might be highly effective in enhancing magnet stability and protection. This concept was developed and a sample conductor manufactured and tested in comparison with an identical conductor lacking such an additional barrier. Results of these conductor tests confirm the potential value of such a barrier. Since the work of tasks 1 through 3 has been reported in detail in quarterly and semiannual reports, as well as in special reports prepared throughout the course of this project, this report reviews early work briefly and then discusses this last phase in great detail. DOE

N91-18883# Argonne National Lab., IL.
SECOND HARMONIC GENERATION AND SUM FREQUENCY GENERATION
M. J. Pellin, B. M. Biwer, M. W. Schauer, J. M. Frye, and D. M. Gruen 1990 14 p Presented at the 178th Meeting of the

Electrochemical Society, Seattle, 14-19 Oct. 1990
(Contract W-31-109-eng-38)
(DE91-006654; CONF-901073-12) Avail: NTIS HC/MF A03

Second harmonic generation and sum frequency generation are increasingly being used as in situ surface probes. These techniques are coherent and inherently surface sensitive by the nature of the mediums response to intense laser light. Here we will review these two techniques using aqueous corrosion as an example problem. Aqueous corrosion of technologically important materials such as Fe, Ni and Cr proceeds from a reduced metal surface with layer by layer growth of oxide films mitigated by compositional changes in the chemical makeup of the growing film. Passivation of the metal surface is achieved after growth of only a few tens of atomic layers of metal oxide. Surface Second Harmonic Generation and a related nonlinear laser technique, Sum Frequency Generation have demonstrated an ability to probe the surface composition of growing films even in the presence of aqueous solutions. DOE

N91-18884# Ames Lab., IA.
FIRST-PRINCIPLES STUDY OF THE CONTRACTIVE RECONSTRUCTION OF GOLD AND SILVER MONOLAYERS ON GOLD, SILVER, AND ALUMINUM Ph.D. Thesis
Noboru Takeuchi 16 Nov. 1990 135 p
(Contract W-7405-eng-82)
(DE91-006692; IS-T-1497) Avail: NTIS HC/MF A07

Using first-principles calculations in conjunction with modeling techniques, the author has investigated the structures of Au and Ag monolayers on a number of metal surfaces. Au(100) has a c(26 x 68) surface unit cell and the reconstruction has been interpreted as the top layer transforming to a contracted hexagonal-close-packed layer, superimposed on the square lattice of the underlying substrate atoms. Similar reconstructions have been observed on the 5d fcc metals Ir and Pt, but not in the 4d Rh, Pd, and Ag. The author studied the energetics of a monolayer of Au and Ag using first-principles calculations. The author found that it is energetically favorable for both Au and Ag to transform from a square to hexagonal arrangement and to contract to a higher surface density, but Au gains substantially more energy than Ag. This is true both for a monolayer in isolation as well as on top of a jellium surface. The author also calculated the mismatch energy (energy loss when the top layer loses registry with the substrate) for Au and Ag, and found that Ag has a slightly higher mismatch energy. The first-principles results thus offer a strong indication that Au(100) can reconstruct but Ag will not. The reconstruction is further studied with a two-dimensional Frenkel-Kontorowa model, with parameters extracted from the total energy calculations. The author found that it is indeed energetically favorable for the top layer of Au(100), but not for Ag, to transform to a hexagonal-close-packed structure and contract. DOE

N91-18885# Sandia National Labs., Albuquerque, NM.
SELECTIVE SUPPRESSION OF CARRIER-DRIVEN PHOTOCHEMICAL ETCHING: RAMAN SPECTROSCOPY AS A DIAGNOSTIC TOOL
C. I. H. Ashby, D. R. Myers, G. A. Vawter, R. M. Biefeld, and J. F. Klem 1990 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC04-76DP-00789)
(DE91-007495; SAND-90-1740C; CONF-901105-91) Avail: NTIS HC/MF A02

Carrier-driven photochemical etching of semiconductors can be selectively suppressed by altering the near-surface region to enhance carrier recombination, thereby reducing the supply of carriers that drive the surface etching reaction. Two methods for enhancing recombination and decreasing the etch rate at a given phonon flux include ion implantation and localized Zn diffusion. Raman spectroscopy can be employed to determine whether sufficient alterations of electronic properties has occurred to suppress etching. Carrier-driven photochemical reactions, which require direct participation of free carriers for the chemical reaction to proceed, can be selectively suppressed by increasing the minority carrier recombination rate, thereby reducing the supply of carriers that drive the surface etching reaction. Two methods for enhancing recombination and decreasing the etching quantum yield, which is the number of atoms removed per incident photon, include ion implantation and localized Zn diffusion. For ion implantation, recombination-promoting defect concentrations depend on ion species, fluence, and annealing both during and after the implantation process. Other recombination processes related to carrier scattering from ionized impurities from in-diffusion of dopants or following implant activation can control etching. Raman spectroscopy can be employed to detect changes in electronic properties that correlate with etching suppression. Changes that occur in the LO-phonon lineshape, such as those associated with phonon confinement and ionized impurity scattering, can be diagnostic of the carrier-driven etching behavior following a specific treatment. We have demonstrated two applications of Raman spectroscopy as a diagnostic for suppression of the carrier-driven photochemical etching of GaAs. DOE

N91-18886# Lawrence Livermore National Lab., CA.
DEVELOPMENT OF SCALING RULES FOR RUTHERFORD TYPE SUPERCONDUCTING CABLES
J. M. Royet and R. M. Scanlan Sep. 1990 5 p Presented at the Applied Superconductivity Conference, Aspen, 24-28 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-007644; LBL-28883; CONF-900944-41) Avail: NTIS HC/MF A01

During the R and D phase of the Superconducting Supercollider (SSC) program, LBL was responsible for establishing the parameters for cables used in SSC dipole and quadrupole magnets. In addition, the design and fabrication of a new cable for use in the Low Beta Quadrupoles. As a result of the development work on these and other cables, we have arrived a set of scaling rules which provide guidelines for choosing the parameters for a wide range of superconducting cables. These parameters include strand size, strand number, keystone angle, percent compaction, cable pitch and compacted cable dimensions. In addition, we have defined the tolerance ranges for the key cable manufacturing parameters such as mandrel size and shape, stand tension, and Turkshead temperature control. In this paper, we present the results on cables ranging from 8 strands to 36 strands of 0.65mm wire and from 8 strands to 30 strands of 0.8mm wire. We use these results to demonstrate the application of the scaling rules for Rutherford-type cable. DOE

N91-18299*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SURFACE AND IMPLANTATION EFFECTS ON p-n JUNCTIONS
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 201-204 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

N91-18300*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROPERTIES OF INSULATOR INTERFACES WITH p-HgCdTe
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 205-207 Repr. from Journal of Vacuum Science Technology, v. 8, no. 2, Mar./Apr. 1990 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

N91-18301*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SURFACE ELECTRONS IN INVERTED LAYERS OF p-HgCdTe
Samuel E. Schacham and Eliezer Finkman (Technion - Israel Inst. of Tech., Haifa.) *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June

1990 Jun. 1990 p 208-214 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

N91-18304*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ELLIPSOMETRIC STUDY OF CUBIC SiC Abstract Only
Samuel A. Alterovitz, Neil S. Shoemaker, and J. A. Powell *In its* Solid State Technology Branch of NASA Lewis Research Center Second Annual Digest, June 1989 - June 1990 Jun. 1990 p 239 (For primary document see N91-18297 10-32)
Avail: NTIS HC/MF A13 CSCL 20L

N91-18968*# Puerto Rico Univ., Rio Piedras. Dept. of Physics R. U. M.
EFFECTS OF ANTIMONY SUBSTITUTION ON BISMUTH BASED SUPERCONDUCTORS
Alfonso Barrientos *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 12 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20F

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N91-18887# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.
MULTIPLE PARTICLE PRODUCTION PROCESSES IN THE LIGHT OF QUANTUM OPTICS
Erwin M. Friedlander Sep. 1990 14 p Presented at the International Workshop on Correlations and Multiparticle Production, Marburg, Fed. Republic of Germany, 14-16 May 1990
(Contract DE-AC03-76SF-00098)
(DE91-005290; LBL-29641; CONF-9005245-5) Avail: NTIS HC/MF A03

Ever since the observation that high-energy 'nuclear active' cosmic-ray particles create bunches of penetrating particles upon hitting targets, a controversy has raged about whether these secondaries are created in a 'single act' or whether many hadrons are just the result of an intra-nuclear cascade, yielding one meson in every step. I cannot escape the impression that the latter kind of model appeals naturally as a consequence of an innate bio-morphism in our way of thinking and that in one guise or another it has tenaciously survived to this day, also for hadron-hadron collisions, via multi-peripheral models to the modern parton shower approach. Indeed, from the very beginning of theoretical consideration of multiparticle production, the possibility of many particles arising from a single 'hot' system has been explored, with many fruitful results, not the least of which are the s(sup 1/4) dependence of the mean produced particle multiplicity and the 'thermal' shape of the P(sub T) spectra. An important consequence of the thermodynamical-hydrodynamical models is that particle emission is treated in analogy to black-body radiation, implying for the secondaries a set of specific Quantum-Statistical properties, very similar to those observed in quantum optics. From here on I shall try to review a number of implications and applications of this QS analogy in the study of multiplicity distributions of the produced secondaries. I will touch only in passing another very important topic of this class, the Bose-Einstein two-particle correlations. DOE

N91-18888# Los Alamos National Lab., NM. Theoretical Analysis Div.
ENVIRONMENT-INDUCED SUPERSELECTION IN COSMOLOGY
Wojciech H. Zurek 1990 18 p Presented at the Quantum Gravity Symposium, Moscow, USSR, May 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE91-005948; LA-UR-90-4365; CONF-9005300-1) Avail: NTIS HC/MF A03

Interaction between a quantum system and its environment can be often regarded as a measurement, in the course of which one of the system observables influences the evolution of the external degrees of freedom and is thus monitored by the environment. This causes the system to decohere. Loss of quantum coherence erases part of the density matrix responsible for the correlations between the eigenstates of the monitored observables. This mechanism is very efficient even in the limit of weak coupling to the environment. The classical limit of quantum theory, i.e., both classical irreversible equations of motion and classical states (trajectories in phase space rather than their superpositions) obtains in the limit in which the coupling strength and the Planck constant simultaneously tend to zero. Transition from quantum to classical in the inflationary cosmological model can be justified in the framework of environment induced susperselection. DOE

N91-18889# Pacific Northwest Lab., Richland, WA.
LOCAL ENTROPY GENERATION ANALYSIS OF A ROTARY MAGNETIC HEAT PUMP REGENERATOR
M. Kevin Drost and Mark D. White Apr. 1990 20 p Presented at the ASME Winter Annual Meeting, Dallas, TX, 25-30 Nov. 1990
(Contract DE-AC06-76RL-01830)
(DE91-005520; PNL-SA-17787; CONF-901194-8) Avail: NTIS HC/MF A03

The rotary magnetic heat pump has attractive thermodynamic performance but it is strongly influenced by the effectiveness of the regenerator. This study uses local entropy generation analysis to evaluate the regenerator design and to suggest design improvements. The results show that performance of the proposed design is dominated by heat transfer related entropy generation. This suggests that enhancement concepts that improve heat transfer should be considered, even if the enhancement causes a significant increase in viscous losses (pressure drop). One enhancement technique, the use of flow disrupters, was evaluated and the results showed that flow disrupters can significantly reduce thermodynamic losses. DOE

N91-18890# Argonne National Lab., IL. Reactor Analysis and Safety Div.
EVALUATION OF A CENTRAL-DIFFERENCE-LIKE METHOD FOR THE SOLUTION OF THE CONVECTION-DIFFUSION EQUATION
Constantine P. Tzanos 1990 6 p Presented at the American Nuclear Society Winter Meeting, Washington, DC, 11-15 Nov. 1990
(Contract W-31-109-eng-38)
(DE91-006550; CONF-901101-78) Avail: NTIS HC/MF A02

For the numerical solution of the transport equation that describes the convection and diffusion of various physical quantities (e.g., momentum, heat, and material concentrations) first-order upwind schemes are widely used. For example, first order upwind differencing is used in codes like COMMIX and PHOENICS. These schemes are simple and always give oscillation-free and physically plausible solutions. However, due to false diffusion, at high Peclet numbers their accuracy on practical meshes is poor. In previous work, a central-difference-like method was presented that even with a coarse mesh produces oscillation-free solutions and of superior accuracy than the upwind scheme. For the evaluation of this method, previous work used the test problem of Smith and Hutton for Peclet numbers ranging from 10 to infinity. To further evaluate this method, in this work results are presented from its application to another benchmark problem of computational fluid dynamics. This problem is laminar isothermal flow in a square cavity driven by a sliding lid. DOE

N91-18891# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
IS VACUUM QUADRATIC POINCARE GAUGE FIELD THEORY

A VIABLE GAUGE THEORY OF GRAVITATION
P. Singh Nov. 1990 25 p
(MATHS-REPT-A-137; ETN-91-98636) Avail: NTIS HC/MF A03

Some foundations of the vacuum QPGFT (Quadratic Poincare Gauge Field Theory) are discussed, including the correspondence with general relativity, confinement, holonomy, Hamiltonian formalization, Birkoff theorem and the principles of minimal coupling and gauge invariance. It is established that the description of matter in terms of classical fields is illegitimate and that the QPGFT needs grading and extension to the gauge theory of the four dimensional real affine group of the metric affine theory. It is concluded that the vacuum QPGFT is not a viable microscopic gauge theory of gravitation. ESA

N91-18892# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
CAUSAL VECTOR SPACES: A GENERALIZATION OF THE MINKOWSKI MODELS FOR THE SPECIAL THEORY OF RELATIVITY Ph.D. Thesis [KAUSALE VEKTORRAEUME: EINE VERALLGEMEINERUNG DES MINKOWSKI-MODELLS FUER DIE SPEZIELLE RELATIVITAETSTHEORIE]
Martin Schneeweiss 1990 174 p In GERMAN
(ETN-91-98784) Avail: NTIS HC/MF A08

The causality concept is represented by a causal cone, which describes the causal relationship between events and induces the structure of a causal space on the quantity of events. The time vectors, e.g., the internal points of this cone induce real functions, which give the appropriate conformal class of metrics, in the special case of the Minkowski space. Some properties of these functions are examined. The group of causal automorphisms of the event space, which is in agreement with the Lorentz group for the Minkowski space, is composed of affine transformations, in the case of a strict convexity of the causal cone. ESA

N91-18893# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
CAUSALITY VIOLATION AND SINGULARITIES Ph.D. Thesis
Marcus Kriele 1990 110 p
(ETN-91-98795) Avail: NTIS HC/MF A06

The relation between causality violation and the existence of singularities in general relativity is explored. A generalization of the singularity theorem of Hawking and Penrose (1970) to a wide class of spacetimes with causality violations is found. The generalization is the only one that preserves the original idea of the theorem and does not demand further conditions on the energy momentum tensor. By quoting an example of Newman (1989a) it is shown that the generalization is unlikely to be extended. A similar generalization for a theorem of Hawking (1967) asserting the occurrence of a singularity in the past of a trapped point was also found. Every compact component of the boundary of the chronology violating set contains almost closed incomplete null geodesics. Moreover, it is not a C2 submanifold. As a consequence chronology violation that does not extend to infinity causes singularities. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N91-18894*# National Aeronautics and Space Administration, Washington, DC.
NASA COMMERCIAL PROGRAMS Progress Report, 1989
1990 31 p Original contains color illustrations
(NASA-TM-103410; NAS 1.15:103410) Avail: NTIS HC/MF A03; 21 functional color pages CSCL 05A

Highlights of NASA-sponsored and assisted commercial space activities of 1989 are presented. Industrial R and D in space, centers for the commercial development of space, and new cooperative agreements are addressed in the U.S. private sector in space section. In the building U.S. competitiveness through technology section, the following topics are presented: (1) technology utilization as a national priority; (2) an exploration of benefits; and (3) honoring Apollo-Era spinoffs. International and domestic R and D trends, and the space sector are discussed in the section on selected economic indicators. Other subjects included in this report are: (1) small business innovation; (2) budget highlights and trends; (3) commercial programs management; and (4) the commercial programs advisory committee. K.S.

N91-18895*# National Aeronautics and Space Administration, Washington, DC.
SELLING TO NASA
1990 58 p Original contains color illustrations
(NASA-NP-123; NAS 1.83:123) Avail: NTIS HC/MF A04; 39 functional color pages CSCL 05A

This handbook is designed to promote a better understanding of NASA's interests and the process of doing business with NASA. The document is divided into the following sections: (1) this is NASA; (2) the procurement process; (3) marketing your capabilities; (4) special assistance programs; (5) NASA field installations; (6) sources of additional help; (7) listing of NASA small/minority business personnel; and (8) NASA organization chart. K.S.

N91-18896# Technische Univ., Eindhoven (Netherlands). Faculteit Bedrijfskunde.
[ACTIVITIES REPORT ON THE SCIENTIFIC RESEARCH AT THE FACULTY OF MANAGEMENT SCIENCE] Annual Report, 1989 [RAPPORTAGE WETENSCHAPPELIJK ONDERZOEK, 1989]
1990 286 p In DUTCH
(ETN-91-98770) Avail: NTIS HC/MF A13

Planning systems for production and maintenance were developed and analyzed. Organization systems for production and work tasks were designed and analyzed. Methods for information analysis in an office environment, as well as data models, data bases, and decision support systems, were studied. The organization and management of technical product innovation were analyzed. Production with minimum energy consumption was studied. Management in companies and society, as well as strategy formation and technical innovation were studied. Quantitative methods for operational research and statistics were developed. The relative performance of technical production systems was studied. ESA

N91-18897# Winand Staring Centre, Wageningen (Netherlands). Inst. voor Onderzoek van het Landerlijk Gebied.
[ACTIVITIES REPORT OF THE WINAND STARING CENTER] Annual Report, 1989 [JAARVERSLAG 1989, STARING CENTRUM]
1990 68 p In DUTCH
(ISBN-90-327-0239-4; ETN-91-98775) Copyright Avail: NTIS HC/MF A04

The data on soil and ground water in the province of Drenthe were revised. Integral water management, removal of phosphates from agricultural land, and the correlation between pesticides and herbicides and ground water quality were studied. Water management in the Nile delta in Egypt, and problems with soils

containing pyrites in Indonesia are discussed. A data base for land use in the Netherlands was established. An agro-ecological characterization of rural areas in the European Community is given. The effect of atmosphere deposits on the soil of the Speulderbos was investigated. The influence of agricultural land users and the management of nature and landscape was studied. Traffic regulation in rural areas, and open air recreation projects were investigated. ESA

N91-18999*# Wisconsin Univ., Platteville. Dept. of Industrial Engineering.
INFORMATION AND PROBLEM REPORT USAGE IN SYSTEM SAFTEY ENGINEERING DIVISION
Stephen J. Morrissey *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N91-18898*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT: THE RELATIONSHIP BETWEEN THE USE OF US GOVERNMENT TECHNICAL REPORTS BY US AEROSPACE ENGINEERS AND SCIENTISTS AND SELECTED INSTITUTIONAL AND SOCIOMETRIC VARIABLES Ph.D. Thesis - Indiana Univ., Nov. 1990 Report No. 6
Thomas E. Pinelli Jan. 1991 352 p
(Grant NAGw-1682)
(NASA-TM-102774; NAS 1.15:102774) Avail: NTIS HC/MF A16 CSCL 05B

The relationship between the use of U.S. government technical reports by U.S. aerospace engineers and scientists and selected institutional and sociometric variables was investigated. The methodology used for this study was survey research. Data were collected by means of a self-administered mail questionnaire. The approximately 34,000 members of the American Institute of Aeronautics and Astronauts (AIAA) served as the study population. The response rate for the survey was 70 percent. A dependent relationship was found to exist between the use of U.S. government technical reports and three of the institutional variables (academic preparation, years of professional aerospace work experience, and technical discipline). The use of U.S. government technical reports was found to be independent of all of the sociometric variables. The institutional variables best explain the use of U.S. government technical reports by U.S. aerospace engineers and scientists. Author

N91-18899# Creusot-Loire, Firminy (France).
MATERIALS DATA BASES FOR FATIGUE
C. Amzallag and D. Lehmann (Commissariat a l'Energie Atomique, Gif-sur-Yvette, France) 1991 16 p
Avail: NTIS HC/MF A03

A collaborative program was undertaken to produce recommended practices for fatigue testing, taking into account the evolution of actual apparatus and test methods. These recommendations deal with both the practice of the tests and standard presentations of the results which could be used to build data bases. The work already performed (low-cycle fatigue tests) and that in progress (fatigue crack growth test, high cycle fatigue test), and a scheme of a general factual data base are outlined. The approach presented is essentially applied to metallic materials, though it can be transposed to other types of materials. Author

N91-18900# National Research Inst. for Metals, Tokyo (Japan).
RESEARCH AND DEVELOPMENT OF MATERIALS DATABASES IN JAPAN
Satoshi Nishijima 1991 7 p
Avail: NTIS HC/MF A02

The fundamental policy to develop a scientific and technological information system in Japan is based on the scheme of a national information system for science and technology (NIST). A brief explanation on the NIST concept is presented after a short comment on the historical background. Then, a rapid survey of typical public-open, on-line services of materials data and of the recent tendency of CD-ROM type commercial databases is discussed. Emphasis is on the significance of data modeling for evaluation which is currently under discussion at the VAMAS Technical Working Party on Materials Databases. Author

N91-18901# Sandia National Labs., Albuquerque, NM. Information Systems Design Div.
EXPERIENCE WITH MORE PRODUCTIVE INFORMATION SYSTEMS DESIGN AT SANDIA NATIONAL LABORATORIES
John K. Sharp 1990 94 p Presented at the HET Invorenvande Volgendegeneratie Conference, Amsterdam, Netherlands, 29 Nov. 1990
(Contract DE-AC04-76DP-00789)
(DE91-005237; SAND-90-2983C; CONF-9011161-1) Avail: NTIS HC/MF A05

The natural language technique was just one of many approaches to information system design in 1987. The success of this approach convinced management of the viability of this 'new' approach. A group was created to use natural language in information system specifications and designs. Two of the projects undertaken by this group will be reviewed. The first is a quality database that allows for the management of the process that certifies production capabilities for major weapon components and the second tracks command and control status of weapons. A third external project involving nuclear disarmament will also be discussed. DOE

N91-18902# Argonne National Lab., IL. Energy Systems Div.
USER'S GUIDE FOR THE DATA ANALYSIS, RETRIEVAL, AND TABULATION SYSTEM (DARTS), REVISED EDITION: A MAINFRAME COMPUTER CODE FOR GENERATING CROSS-TABULATION REPORTS
John L. Anderson Oct. 1990 37 p
(Contract W-31-109-eng-38)
(DE91-006615; ANL/ESD/TM-12) Avail: NTIS HC/MF A03

A computer system unknown as the Data Analysis, Retrieval, and Tabulation System (DARTS) was developed by the Energy Systems Division at Argonne National Laboratory to generate tables of descriptive statistics derived from analyses of housing and energy data sources. Through a simple input command, the user can request the preparation of a hierarchical table based on any combination of several hundred of the most commonly analyzed variables. The system was written in the Statistical Analysis System (SAS) language and designed for use on a large scale IBM mainframe computer. DOE

N91-18903# Sandia National Labs., Albuquerque, NM.
PREDICTIVE DATA COMPRESSION WITH EXACT RECOVERY (SUMMARY)
S. D. Stearns 1990 9 p Presented at the 1991 IEEE Data Compression Conference, Snowbird, 8-10 Apr. 1991
(Contract DE-AC04-76DP-00789)
(DE91-005863; SAND-90-3202C; CONF-9104139-1-SUMM)
Avail: NTIS HC/MF A02

A two-stage data compression technique that provides for exact, bit-for-bit recovery is described. The first stage is a modified form of conventional linear prediction which generates an error or residue sequence in such a way that exact reconstruction of the original data sequence can be accomplished with a simple recovery algorithm. The second stage is bi-level sequence coding. Even though the residue sequence from the first stage is essential white and Gaussian with seismic or other similar waveform data, bi-level

sequence coding will generally provide further compression. The complete technique is described briefly in this summary, and examples of its performance are presented. A full paper on the algorithm is available from the author. DOE

N91-18904# Lawrence Livermore National Lab., CA.
EDITING GRAPHS FOR MAXIMUM EFFECT
P. W. Murphy and R. W. Rhiner Jan. 1991 6 p Presented at the 38th International Technical Communication Conference, New York, Apr. 1991
(Contract W-7405-eng-48)
(DE91-006239; UCRL-JC-104660; CONF-910441-3) Avail: NTIS HC/MF A02

The paper contains over eighty rules for editing graphs, arranged under nine major headings in a logical sequence for editing all the graphs in a manuscript. It is excerpted from a monograph used at the Lawrence Livermore National Laboratory to train beginning technical editors in editing graphs; a corresponding Hypercard stack is also used in this training. DOE

N91-18905# Oak Ridge National Lab., TN.
ESTABLISHING FUNCTIONAL REQUIREMENTS FOR EMERGENCY MANAGEMENT INFORMATION SYSTEMS
J. H. Reed, G. O. Rogers, and J. H. Sorensen 1991 9 p Presented at the Society for Computer Simulation Western Multiconference, Anaheim, 23-25 Jan. 1991
(Contract DE-AC05-84OR-21400)
(DE91-006340; CONF-910128-3) Avail: NTIS HC/MF A02

The advancement of computer technologies has led to the development of a number of emergency management information systems (e.g., EIS, CAMEO, IEMIS). The design of these systems has tended to be technologically driven rather than oriented to meeting information management needs during an emergency. Of course, emergency management needs vary depending on the characteristics of the emergency. For example, in hurricanes, onset is typically slow enough to allow emergency managers to simulate evacuations dynamically while in chemical disasters onset may be sufficiently rapid to preclude such simulation(s). This paper describes a system design process in which the analysis of widely recognized emergency management functions was used to identify information requirements and the requisite software and hardware capabilities to deal with rapid onset, low probability, high consequence events. These requirements were then implemented as a prototype emergency management system using existing hardware and software to assure feasibility. Data, hardware, and software requirements were further developed, refined, and made more concrete through an iterative prototyping effort. This approach focuses attention directly on meeting emergency management information needs while avoiding unneeded technological innovations. DOE

N91-18906# Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV.
INDEX OF THE NEVADA APPLIED ECOLOGY GROUP AND ASSOCIATED PUBLICATIONS AVAILABLE IN THE COORDINATION AND INFORMATION CENTER
B. G. Maza Feb. 1991 139 p
(Contract DE-AC08-89NV-10630)
(DE91-007178; DOE/NV-10630/13) Avail: NTIS HC/MF A07

This publication was created by the Coordination and Information Center (CIC) to provide a readily available research tool for use by researchers interested in a specific area covered in the holdings of the CIC Archives. The Nevada Applied Ecology Group (NAEG) was formed and functioned in agreement with Planning Directive NVO-76 to coordinate the ecological and other environmental programs necessary to support the continued nuclear testing activities; and to provide a mechanism to effectively comply with requirements of the National Environmental Policy Act of 1969. The publication contains only citations to documents currently available at the CIC. It represents a significant portion of the principal research findings of the Nevada Applied Ecology Group. DOE

N91-18907# Lawrence Livermore National Lab., CA.
TECHNICAL PUBLICATION TRANSFER TEST WITH VITRO CORPORATION: MIL-M-28001 (SGML) AND MIL-D-28000 CLASS 1 (IGES)
18 Sep. 1990 10 p
(Contract W-7405-eng-48)
(DE91-007609; UCRL-ID-104305; CTN-90-013) Avail: NTIS HC/MF A02

The purpose of the informal test reported in this Quick Short Test Reports was to analyze Vitro Corporation's interpretation and use of the Computer-aided Acquisition and Logistic Support (CALS) standards in transferring technical publications data. Vitro used its CALS Technical Data Interchange System to produce data in accordance with the Standards and delivered it to the CALS Test Network (CTN) technical staff on a 9-track magnetic tape. DOE

N91-18908# Lawrence Livermore National Lab., CA.
TECHNICAL PUBLICATION TRANSFER TEST WITH MCDONNELL AIRCRAFT COMPANY: MIL-M-28001 (SGML) AND MIL-D-28000 CLASS 1 (IGES)
25 Jun. 1990 27 p
(Contract W-7405-eng-48)
(DE91-007610; UCRL-ID-104492; CTN-90-001) Avail: NTIS HC/MF A03

The CALS Test Network (CTN) conducted a CTN Planned Test (CPT) of several CALS standards related to the transfer of technical publication data: MIL-STD-1840A (1840A), MIL-D-28000 Class I (28000), MIL-M-28001 (28001), and MIL-D-28003 (28003). The test was conducted with the McDonnell Aircraft Company (CMAIR) of St. Louis, Missouri in accordance with part one of CTN Test Plan CTN89-TM-06 and using material from an F-15E technical manual. One focus of the test was the transfer of a moderately large volume of technical publication data. There were 9 text files, 74 Initial Graphics Exchange Specification (IGES) files, and 74 Computer Graphics Metafile (CGM) files in the exchange package. A noteworthy feature of the test was its early attempt to exchange CGM data. Part one of CTN89-TM-06 called for technical publication data to be output from MCAIR's Xyvision system on 9-track magnetic tape. The data was to be in accordance with the 28001 subset of the Standard Generalized Mark-up Language (SGML) and the 28001 Document Type Definition (DTD) that conformed to MIL-M-38784B, the general style and format requirements for technical manuals. Technical illustrations in the manual were to be done in accordance with 28000 Class I (IGES) and 28003 (CGM). Part two of the test called for the test tape to be read into another technical publication system where the text would be modified and the vector illustrations would all be converted to raster, in accordance with MIL-R-28002. This part of the test is not covered in this report. DOE

N91-18022# Wichita State Univ., KS. National Inst. for Aviation Research.
AN OVERVIEW OF INFORMATION RESOURCES IN AVIATION Abstract Only
Thomas G. DePetro *In its* Proceedings: Techfest 17 1991 p 21 (For primary document see N91-18004 10-01)
Avail: NTIS HC/MF A03

N91-18620*# Houston Univ., Clear Lake, TX. Space Business Information Center.
AN OVERVIEW OF THE INFORMATION MANAGEMENT COMPONENT OF RICIS Abstract Only
Peter C. Bishop *In its* RICIS 1987 Symposium. Executive Summary 1987 2 p (For primary document see N91-18616 10-61)
Avail: NTIS HC/MF A15 CSCL 12A

N91-18970*# Alabama A & M Univ., Huntsville. Dept. of Mathematics.
UPDATING AND AUGMENTING NASA SPACELINK ELECTRONIC INFORMATION SYSTEM
Jean A. Blake *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990

7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05B

N91-18972*# Alabama Univ., Huntsville. Dept. of Computer Science.
NAVIGATION IN LARGE INFORMATION SPACES REPRESENTED AS HYPERTEXT: A REVIEW OF THE LITERATURE
Marcus Brown *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05B

N91-18983*# University of Southern Mississippi, Hattiesburg. Dept. of Management Information Systems.
NASA ACCOUNTING AND FINANCIAL INFORMATION SYSTEM (NAFIS): A CRITICAL ASSESSMENT OF THE SYSTEMS DEVELOPMENT METHODOLOGY
Ernest Preston Goss *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Contract NAS8-37200)
Avail: NTIS HC/MF A16 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N91-18206# European Space Agency, Paris (France).
SOME COMMENTS ON MULTILATERAL COOPERATION
In its Manned Space Stations: Their Construction, Operation and Potential Applications Nov. 1990 p 117-119 (For primary document see N91-18201 10-18)
Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

No abstracts in this category.

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N91-18909# Naval Observatory, Washington, DC.
THE NAUTICAL ALMANAC FOR THE YEAR 1990
1990 359 p
Avail: NTIS HC/MF A16; also available SOD HC $16.00 as 008-054-00130-1

The object of this almanac is to provide the ephemerides and other data required for astronomical navigation at sea. The main content of the almanac consists of data from which the Greenwich hour angle (GHA) and the declination of all bodies used for navigation can be obtained for any instant of Greenwich Mean Time (GMT). The remaining data include rising and setting times of the Sun and Moon, and times of twilight; miscellaneous calendarial and planning data; auxiliary tables including a list of standard times; and corrections for observed altitude. M.G.

N91-18910 Stanford Univ., CA.
MODELING AND SHAPE CONTROL OF A SEGMENTED-MIRROR TELESCOPE Ph.D. Thesis
Alain Charles Carrier 1990 389 p
Avail: Univ. Microfilms Order No. DA9024315

The Advanced Structure Control Integrated Experiment (ASCIE) is an optical telescope consisting of seven hexagonal segments mounted on a lightweight flexible truss. The position and the attitude of the six peripheral segments are actively controlled by 18 electromagnetic actuators to keep the segments optically aligned. Some 24 inductance sensors are used to measure the relative displacements between the segments. Disturbability, controllability and static fidelity analyses are used to eliminate modes from the finite element model while keeping enough of the dynamic and static characteristics of the system for evaluation and control design purposes. New optimal and aggregation based algorithms are introduced for matching impulse and step responses. A systematic norm preserving procedure is developed to take advantage of the six fold symmetry of the ASCIE and to decompose the control design model into input/output decoupled subsystems. Worst case control design methods that trade performance, parameter stability margins, and spillover margins are used to synthesize the control laws. Dissert. Abstr.

N91-18911*# Space Telescope Science Inst., Baltimore, MD.
A STRATEGY FOR RECOVERY: REPORT OF THE HST STRATEGY PANEL Special Study, Aug. - Oct. 1990
R. A. Brown, ed. and H. C. Ford, ed. 1991 110 p
(Contract NAS5-26555)
(NASA-CR-187826; NAS 1.26:187826) Avail: NTIS HC/MF A06 CSCL 03A

The panel met to identify and assess strategies for recovering the Hubble Space Telescope (HST) capabilities degraded by a spherical aberration. The panels findings and recommendations to correct the problem with HST are given. The optical solution is a pair of mirrors for each science instrument field of view. The Corrective Optics Space Telescope Axial Replacement (COSTAR) is the proposed device to carry and deploy the corrective optics. A 1993 servicing mission is planned. E.R.

N91-18912# Lawrence Livermore National Lab., CA.
A SEARCH FOR MASSIVE COMPACT HALO OBJECTS IN OUR GALAXY
C. Alock, T. Axelrod, K. Cook, H. Park, K. Griest, C. Stubbs

(California Univ., Berkeley.), K. Freeman, B. Peterson, P. Quinn, and A. Rodgers 19 Dec. 1990 6 p Presented at the Astrophysics Workshop: After the First Three Minutes, College Park, MD, 15-17 Oct. 1990
(Contract W-7405-eng-48)
(DE91-007624; UCRL-JC-105813; CONF-9010268-3) Avail: NTIS HC/MF A02

Massive Compact Halo Objects (MACHOs) such as brown dwarfs, Jupiters, and black holes are prime candidates to comprise the dark halo of our galaxy. Paczynski noted that these objects can be detected via gravitational microlensing of stars in the Magellanic Clouds with the caveat that only about one in 10(exp 6) stars will be lensed at any given time. Our group is currently involved in constructing a dedicated observing system at the Mount Stromlo Observatory in Australia. We will use a refurbished 1.27 meter telescope and an innovative two-color CCD camera with 3.4 times 10(exp 7) pixels to monitor 10(exp 6) minus 10(exp 7) stars in the Magellanic Clouds. During first year of operation (1991 to 1992), we hope to detect (or rule out) objects in the mass range 0.001 solar magnitude approximately less than M approximately less than 0.1 solar magnitude, and after five years, we hope to have covered the range 10(exp -6) solar magnitude less than M approximately less than 100 solar magnitude. DOE

N91-18913# California Univ., Berkeley. Lawrence Berkeley Lab.
AN OPTICAL AND NEAR INFRARED SEARCH FOR A PULSAR IN SUPERNOVA 1987A Ph.D. Thesis
T. P. Sasseen Dec. 1990 80 p
(Contract DE-AC03-76SF-00098)
(DE91-007652; LBL-29992) Avail: NTIS HC/MF A05

We describe a search for an optical pulsar in the remnant of Supernova 1987A. We have performed over one hundred separate observations of the supernova, covering wavelengths from 3500 angstroms to 1.8 microns, with sensitivity to pulsations as faint as magnitude 22.7. As of September 26, 1990, we have not seen evidence for pulsations due to a pulsar in the supernova. We discuss the implications of this result on predictions of pulsar optical luminosity. We have constructed for the search two photodiode detectors and a data system. We describe their design, calibration and performance. These detectors have allowed us to increase our sensitivity as much as a factor of 5 over standard photomultiplier tubes, and extend this search to near infrared wavelengths. DOE

N91-18326*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
PLANETARY EPHEMERIDES APPROXIMATION FOR RADAR ASTRONOMY
R. Sadr and M. Shahshahani *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 219-234 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 03A

N91-18923# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
THE INFRARED SPACE OBSERVATORY (ISO)
L. Metcalfe and M. F. Kessler *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 3-6 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18925# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
FIRST: FAR INFRARED AND SUBMILLIMETRE SPACE TELESCOPE
Urban Frisk *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 13-18 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18932# Observatoire de Paris-Meudon (France).
NEW EFFORTS IN THE SEARCH FOR EXTRASOLAR PLANETS
J. Schneider, M. Chevreton, and E. L. Martin (Universidad de la Laguna, Spain) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 67-71 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18948# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Astronomie.
DISTANCE DETERMINATION OF DARK CLOUDS
Joachim A. Stuewe *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 175-178 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18949# Universidad Nacional Autonoma de Mexico, Villa Obregon. Inst. de Astronomia.
VLA OBSERVATIONS OF AMMONIA IN HERBIG-HARO 1-2
L. F. Rodriguez, J. Canto, J. M. Torrelles, G. Anglada, and P. T. P. Ho (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 179-181 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18952*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IMAGING HIGH-RESOLUTION SPECTROSCOPY IN THE THERMAL INFRARED FOR PLANETARY ATMOSPHERE STUDIES
Guenter R. Wiedemann (National Academy of Sciences - National Research Council, Greenbelt, MD.) and Donald E. Jennings *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 191-192 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18955*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 2.5 TO 5.0 MICROMETER SPECTRAL OF IO: EVIDENCE FOR H2S AND H2O FROZEN IN SO2
F. Salama, L. J. Allamandola, F. C. Witteborn, D. P. Cruikshank, S. A. Sandford, and J. D. Bregman *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 203-208 (For primary document see N91-18922 10-90)
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N91-19000*# University of Southern Alabama, Mobile. Dept. of Civil Engineering.
CONSTRUCTION OF THE 16 METER LARGE LUNAR TELESCOPE (LLT)
Husam Anwar Omar *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 10 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N91-18914 Wisconsin Univ., Madison.
DIFFUSE GAS IN THE INTERSTELLAR MEDIUM: STUDIES INVOLVING COUPLED IONIZATION, RADIATION AND DYNAMICS Ph.D. Thesis
Jonathan David Slavin 1990 78 p
Avail: Univ. Microfilms Order No. DA9027522

A study is presented of the consequences of a conductive boundary on the Local Cloud, the warm low density region immediately surrounding the Sun. The evaporation of the cloud is modeled assuming steady flow. The soft x ray and EUV emission from the interface are calculated and compared with observations. It is found that the emission in the softest x ray band, the Be band, is harder than that of an equilibrium, normal abundance, 10(exp 6)K plasma. The results are also presented of a 1-D (spherical symmetry) numerical simulation of the evolution of a supernova remnant in a homogeneous medium with a 5 micro-G magnetic field and density of 0.2/cu cm. The remnant evolution was followed from the early Sedov-Taylor phase through the final collapse of the hot bubble after 5.5 x 10(exp 6) years. It was found that the evolution of the remnant, once it has become radiative, differs substantially from the equivalent field-free case, having a smaller interior hot bubble and thicker cold shell. Examples of calculated EUV and FUV emission spectra from the hot bubble are presented and their observability discussed. Dissert. Abstr.

N91-18915# Lawrence Livermore National Lab., CA.
THE 2-D AXISYMMETRIC LINE TRANSPORT
John I. Castor, Pieter G. Dykema, and Richard I. Klein (California Univ., Berkeley.) 20 Nov. 1990 12 p Presented at the NATO Advanced Workshop on Stellar Atmospheres: Beyond Classical Models, Trieste, Italy, 3-7 Sep. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-005226; UCRL-JC-105533; CONF-9009308-2) Avail: NTIS HC/MF A03

The methods used in the ALTAIR code for computing the transfer of spectral line radiation in two-dimensional axially-symmetric geometry are described. ALTAIR uses a variable-Eddington-tensor approach in which the transfer equation of non-coherent line scattering is written in moment form, and the moments are closed with an assumed tensor relating the monochromatic pressure tensor and energy density; this Eddington tensor is obtained self-consistently using an accurate angle-dependent solution of the transfer equation. The finite element method for solving the moment system, and the discontinuous finite element method for solving the S(sub n) equation of transfer are described. Two applications of the method are discussed: line formation in uniform cylinders with different length-diameter ratios, and monochromatic transfer on an irregular x-y mesh (the Mordant test problem). DOE

N91-18916*# Tufts Univ., Medford, MA. Dept. of Physics and Astronomy.
SIMULTANEOUS SOLAR MAXIMUM MISSION (SMM) AND VERY LARGE ARRAY (VLA) OBSERVATIONS OF SOLAR ACTIVE REGIONS Final Technical Report, 1 Feb. 1985 - 31 Jan. 1991
Robert F. Willson 28 Feb. 1991 297 p
(Grant NAG5-501)
(NASA-CR-187907; NAS 1.26:187907) Avail: NTIS HC/MF A13 CSCL 03B

Very Large Array observations at 20 cm wavelength can detect the hot coronal plasma previously observed at soft x ray wavelengths. Thermal cyclotron line emission was detected at the apex of coronal loops where the magnetic field strength is relatively constant. Detailed comparison of simultaneous Solar Maximum Mission (SMM) Satellite and VLA data indicate that physical parameters such as electron temperature, electron density, and magnetic field strength can be obtained, but that some coronal loops remain invisible in either spectral domain. The unprecedent spatial resolution of the VLA at 20 cm wavelength showed that the precursor, impulsive, and post-flare components of solar bursts originate in nearby, but separate loops or systems of loops.. In some cases preburst heating and magnetic changes are observed from loops tens of minutes prior to the impulsive phase. Comparisons with soft x ray images and spectra and with hard x ray data specify the magnetic field strength and emission mechanism of flaring coronal loops. At the longer 91 cm wavelength, the VLA detected extensive emission interpreted as a hot 10(exp 5) K interface between cool, dense H alpha filaments and the surrounding hotter, rarefield corona. Observations at 91 cm also provide evidence for time-correlated bursts in active regions on opposite sides of the solar equator; they are attributed to flare triggering by relativistic particles that move along large-scale, otherwise-invisible, magnetic conduits that link active regions in opposite hemispheres of the Sun. Author

N91-18917# Lawrence Livermore National Lab., CA.
CHAOTIC INFLATION AND THE OMEGA PROBLEM
G. J. Mathews, F. Graziani, and H. Kurki-Suonio Dec. 1990 13 p Presented at the International Union of Pure and Applied Physics Conference on Primordial Nucleosynthesis and Evolution of the Early Universe, Tokyo, Japan, 3-8 Sep. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-006253; UCRL-JC-105848; CONF-9009325-1) Avail: NTIS HC/MF A03

One of the most compelling features of inflationary cosmology is that it provides a solution to the flatness problem, i.e., an explanation of the fact that the ratio, Omega, of the present mass density to the closure density is so close to unity. Indeed, inflationary models naturally lead to a present value of the closure parameter which is equal to unity to many significant figures. At the same time, however, there are at least some observational indications that the present value of the closure parameter may be significantly less than unity. At the very least it is probably safe to say that there is no convincing evidence that the present mass density of the universe is not less than half of the closure density. This is the omega problem. The purpose of this paper will be to take the possibility that there is an omega problem seriously and look within the context of inflationary scenarios for a natural explanation as to why the present value of the closure parameter might be so small. DOE

N91-18918*# Fermi National Accelerator Lab., Batavia, IL.
LATE-TIME COSMOLOGICAL PHASE TRANSITIONS
David N. Schramm (Chicago Univ., IL.) Nov. 1990 21 p Presented at the International Union of Pure and Applied Physics Conference on Primordial Nucleosynthesis and Evolution of the Early Universe, Tokyo, Japan, 4-8 Sep. 1990
(Contract NAGw-1321; NAGw-1340; DE-AC02-76CH-03000; NSF AST-88-22595)
(NASA-CR-188001; NAS 1.26:188001; DE91-006381; FERMILAB-CONF-90/245-A; CONF-9009325-4) Avail: NTIS HC/MF A03 CSCL 03B

It is shown that the potential galaxy formation and large scale structure problems of objects existing at high redshifts (Z approx. greater than 5), structures existing on scales of 100 M pc as well as velocity flows on such scales, and minimal microwave anisotropies ((Delta)T/T) (approx. less than 10(exp -5)) can be solved if the seeds needed to generate structure form in a vacuum phase transition after decoupling. It is argued that the basic physics of such a phase transition is no more exotic than that utilized in the more traditional GUT scale phase transitions, and that, just as in the GUT case, significant random Gaussian fluctuations and/or topological defects can form. Scale lengths of approx. 100 M pc for large scale structure as well as approx. 1 M pc for galaxy formation occur naturally. Possible support for new physics that might be associated with such a late-time transition comes from the preliminary results of the SAGE solar neutrino experiment, implying neutrino flavor mixing with values similar to those required for a late-time transition. It is also noted that a see-saw model for

the neutrino masses might also imply a tau neutrino mass that is an ideal hot dark matter candidate. However, in general either hot or cold dark matter can be consistent with a late-time transition. DOE

N91-18919# Fermi National Accelerator Lab., Batavia, IL.
STOCHASTIC INFLATION LATTICE SIMULATIONS: ULTRA-LARGE SCALE STRUCTURE OF THE UNIVERSE
D. S. Salopek Nov. 1990 13 p Presented at the International Union of Pure and Applied Physics Conference on Primordial Nucleosynthesis and Evolution of the Early Universe, Tokyo, Japan, 4-8 Sep. 1990
(Contract NAGw-1340; DE-AC02-76CH-03000)
(DE91-006385; FERMILAB-CONF-90/240-A; CONF-9009325-3)
Avail: NTIS HC/MF A03

Non-Gaussian fluctuations for structure formation may arise in inflation from the nonlinear interaction of long wavelength gravitational and scalar fields. Long wavelength fields have spatial gradients, a(exp -1), small compared to the Hubble radius, and they are described in terms of classical random fields that are fed by short wavelength quantum noise. Lattice Langevin calculations are given for a toy model with a scalar field interacting with an exponential potential where one can obtain exact analytic solutions of the Fokker-Planck equation. For single scalar field models that are consistent with current microwave background fluctuations, the fluctuations are Gaussian. However, for scales much larger than our observable Universe, one expects large metric fluctuations that are non-Guassian. This example illuminates non-Gaussian models involving multiple scalar fields which are consistent with current microwave background limits. DOE

N91-18920# California Univ., Berkeley. Theoretical Astrophysics Center.
HIGH ENERGY PHYSICS AND COSMOLOGY Report, 1 Jun. 1988 - 31 May 1989
Joseph I. Silk and Marc Davis 1989 12 p
(Contract DE-FG03-84ER-40161)
(DE91-006855; DOE/ER-40161/T3) Avail: NTIS HC/MF A03

This research will focus on the implications of recent theories and experiments in high energy physics for the evolution of the early Universe, and on the constraints that cosmological considerations can place on such theories. Several problems are under investigation, including the development of constraints on the inflationary predictions of scale--free primordial fluctuations in a universe at critical closure density by studying their linear and non-linear evolution after they re-enter the particle horizon. We will examine the observable imprint of primordial density fluctuations on the cosmic microwave background radiation curved cosmological models. Most astronomical evidence points to an open universe: one of our goals is to reconcile this conclusion with the particle physics input. We will investigate the response of the matter distribution to a network of cosmic strings produced during an early symmetry-breaking transition, and compute the resulting cosmic microwave background anisotropies. We will simulate the formation of large-scale structures whose dynamics are dominated by weakly interacting particles such as axions, massive neutrinos or photinos in order to model the formation of galaxies, galaxy clusters and superclusters. We will study of the distortions in the microwave background radiation, both spectral and angular, that are produced by ionized gas associated with forming clusters and groups of galaxies. We will also study constraints on exotic cooling mechanisms involving axions and majorons set by stellar evolution and the energy input into low mass stars by cold dark matter annihilation galactic nuclei. We will compute the detailed gamma ray spectrum predicted by various cold dark matter candidates undergoing annihilation in the galactic halo and bulge. DOE

N91-18921# California Univ., Berkeley.
HIGH ENERGY PHYSICS AND COSMOLOGY Report, 1 Jul. 1990 - 31 May 1991
Joseph I. Silk and Marc Davis 1991 10 p
(Contract DE-FG03-84ER-40161)
(DE91-006856; DOE/ER-40161/T4) Avail: NTIS HC/MF A02

The following topics are discussed: annihilations in the galactic halo; cosmic microwave background; stars as particle physics laboratories; large scale structure; galaxy formation; and non-topological solutions. DOE

N91-18922# European Space Agency, Paris (France).
FORMATION OF STARS AND PLANETS, AND THE EVOLUTION OF THE SOLAR SYSTEM
B. Battrick, ed. Nov. 1990 211 p Proceedings of the 24th ESLAB Symposium, Friedrichshafen, Fed. Republic of Germany, 17-19 Sep. 1990
(ESA-SP-315; ISBN-92-9092-102-1; ETN-91-98804) Copyright
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Research relating to the Infrared Space Observatory (ISO), the Cassini mission to Saturn and Titan, the Far-Infrared and Submillimeter Space Telescope (FIRST) and the Comet Nucleus Sample Return Mission (CNSR) is described. Star formation, circumstellar magnetic activity, flares and mass ejections in young stars are discussed. Condensation of the solar nebula and formation of planets is outlined. Evolution of the solar system and prebiotic chemical evolution in the solar system are discussed. For individual titles, see N91-18923 through N91-18957.

N91-18923# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
THE INFRARED SPACE OBSERVATORY (ISO) **c89**
L. Metcalfe and M. F. Kessler *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 3-6 (For primary document see N91-18922 10-90)
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The infrared Space Observatory (ISO), an orbiting astronomical observatory equipped with four complementary and versatile instruments supporting imaging, spectroscopic, photometric and polarimetric observations in the comparatively unexplored wavelength region between 2.5 and 200 microns is described. This European Space Agency (ESA) mission is scheduled for launch in May 1993 and for at least 18 months will provide astronomers with a unique facility for selective observations ranging from solar system studies to observations of sources at cosmological distances. The four ISO instruments, built by international consortia of scientific institutes are described. During launch and operations, they will be mounted behind the primary mirror of the 60 cm diameter cryogenically cooled telescope housed within the satellite's liquid helium cryostat. Two thirds of ISO's observing time will be available to the general astronomical community via the normal route of proposal submission and selection. ESA

N91-18924# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CASSINI: A MISSION TO SATURN AND TITAN **c91**
Jean-Pierre Lebreton and Dennis Matson *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 7-12 (For primary document see N91-18922 10-90)
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The Cassini mission which aims at a detailed exploration of the Saturn's system is reviewed. The Cassini spacecraft is composed of a Saturn orbiter, and a Titan atmosphere probe named Huygens. Cassini is a joint NASA/ESA mission for which ESA is contributing the Huygens probe. The Cassini mission is designed to permit a detailed study of all the elements of the Saturn system, i.e., the planet Saturn, the rings, Titan and the other icy satellites, and the magnetosphere. The Cassini mission will give clues to the understanding of the processes associated with the formation and the evolution of a planetary system and of the solar system as a whole. ESA

N91-18925# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
FIRST: FAR INFRARED AND SUBMILLIMETRE SPACE TELESCOPE **c89**
Urban Frisk *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 13-18 (For primary document see N91-18922 10-90)
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The scientific impact, spacecraft telescope, orbit, thermal control and current status of FIRST, an element of the ESA long term science program are reviewed. FIRST is foreseen as a large (4.5 to 8 m) diameter passively cooled telescope equipped with a combination of photometer/camera and very high resolution spectrometers. The spectrometers will utilize both direct detection and heterodyne techniques to cover the wavelength band 85 to 600 micrometers. The photometers will consist both of bolometers and photoconductor array detectors. FIRST is foreseen to be launched shortly after the year 2000 and will be operated as a facility open to the international scientific community. ESA

N91-18926# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
ROSETTA: THE COMET NUCLEUS SAMPLE RETURN MISSION (CNSR)
Gerhard Schwehm *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 19-23 (For primary document see N91-18922 10-90)
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Rosetta, the Comet Nucleus Sample Return Mission (CNSR), designed to study the pre-solar environment and sample material from interstellar and galactic space is described. Study of the most primitive material in the solar system will provide an experimental approach to the chemical and physical processes that marked the beginning of that system 4.6 billion years ago. Diagrams of the Rosseta/CNSR mission scenario are presented. The Rosetta space segment carrier, lander and Earth re-entry capsule are shown in diagrammatic form. ESA

N91-18927# Leiden Univ. (Netherlands).
THE COSMOCHEMISTRY OF PROTOSTELLAR MATTER
Ewine F. vanDishoeck, Geoffrey A. Blake, and Lee G. Mundy (Maryland Univ., College Park.) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 27-34 (For primary document see N91-18922 10-90)
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The different processes that can affect the chemical composition of matter as it evolves from quiescent molecular clouds into protostellar regions are discussed. Millimeter observations of molecules at high angular resolution in cold, dark clouds such as TMS-1 and L134N reveal large chemical gradients on scales of a few tenths of a pc, which are not well understood. The abundances of the dominant oxygen (H2O, O2, O), and nitrogen (N, N2) bearing species are ill determined both observationally and theoretically, and little is known about some important carbon bearing molecules such as CH4, CO2 and C2H2. Observations of the distribution of molecular material in disks surrounding newly formed low mass stars such as IRAS 16293-2422 are presented. They reveal a complex chemistry observed in the high mass star forming region Orion/KL, despite a factor of 1000 difference in stellar luminosity. A brief comparison with the chemical composition of comets is made. ESA

N91-18928# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Raumsimulation.
THE COALSACK: INTERSTELLAR DUST AND STAR FORMATION
K. J. Seidensticker *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 35-40 (For primary document see N91-18922 10-90)
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The Coalsack is compared to three other dark clouds similar in mass and distance from the Sun, but with very different star formation efficiencies. Nearly all investigations up to date found the Coalsack to be a stable and inactive nebula without any sign for young stellar objects. A model of interstellar extinction curves is applied to stars associated with the clouds under consideration. It is found that in clouds with active star formation the UV extinction, called U(x), is drastically reduced compared to the general interstellar medium, whereas the variations in the strength of the 2200 angstrom bump component are much smaller. These large variations of U(x) can occur either in violent or in calm environments, suggesting different depletion processes of the particles responsible for the UV extinction. ESA

N91-18929# Stockholm Observatory (Sweden).
STAR FORMATION AFTER CORE COLLAPSE
Goesta F. Gahm *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 43-51 (For primary document see N91-18922 10-90)
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The properties of young low mass stars are discussed in relation to the formation of the solar system. The temporal evolution of young stars, like T Tauri stars and post T Tauri stars is discussed. Methods for age determination are reviewed. For comparisons with ideas about the early solar system it is of interest to map how certain parameters derived from observations depend on age and also the observed range at a given age. This may be used to find constraints on cosmogonic theories. The most important parameters available in this context are stellar luminosity, radius and rotation together with masses derived for what appears to be circumstellar disks. The remarkable eruptive process known as the FU Orion phenomenon is discussed as well as the radiative history of the stars. The significance of intensive flare like activity to planetary atmospheres is recognized. ESA

N91-18930# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
CIRCUMSTELLAR MAGNETIC ACTIVITY, FLARES AND MASS EJECTIONS IN YOUNG STARS
B. H. Foing, A. Collier-Cameron, P. Ehrenfreund, and E. Houdebine (Centre National de la Recherche Scientifique, Orsay, France) *In its* Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 53-56 (For primary document see N91-18922 10-90)
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Stellar activity studies are used for information on the early Sun and its environment, and for estimating activity effects on the young solar nebula. Large scale active structures are diagnosed from their rotational modulation signature, and reconstructed in three dimensions, using topographic or Doppler imaging techniques. Young stars undergo violent flares associated with coronal mass ejections leading to mass loss rates that can affect the stellar environment and stellar evolution. Young stars show large coronal condensations, magnetically linked with the stellar surface, that can be destabilized by energetic flares. From a joint ESA/AAT/IUE campaign, masses of such circumstellar clouds around the young star AB Doradus are estimated. These studies allow the problems of the link between circumstellar structures and magnetic activity and the role of mass ejections and flares in the context of mass loss and angular momentum braking in young stars, and early stellar evolution to be addressed. ESA

N91-18931# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Kosmosforschung.
STRUCTURING PROCESSES IN PREPLANETARY DISKS
D. Moehlmann *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 59-65 (For

primary document see N91-18922 10-90)
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Comparable structures in the orbital distribution of planets around the Sun and satellites in the systems of Jupiter, Saturn and Uranus are indications for possible early structuring processes in disks around growing central bodies. Physical mechanisms which are potentially able to generate structures in disks around central bodies are discussed. Physical parameters and conditions which describe effectivity and relevance of these mechanisms of planetogonic processes are derived. Different physical processes investigated as possible candidates for structuring effects, such as resonance interaction of planets or satellites, radial band structures caused by plasma physical processes, regular rings left behind from the shrinking Sun, convection driven radial structures and structuring due to collective gravitational effects in the disk, are reviewed. ESA

N91-18932# Observatoire de Paris-Meudon (France).
NEW EFFORTS IN THE SEARCH FOR EXTRASOLAR PLANETS **c89**
J. Schneider, M. Chevreton, and E. L. Martin (Universidad de la Laguna, Spain) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 67-71 (For primary document see N91-18922 10-90)
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Photometric searching for stellar occultation by planets in the case of dwarf cool stars is discussed. The technique allows for close planetary orbits. The advantages of this configuration for the search of occultations are summarized. Continuous photometric monitoring of about one hundred dwarfs, from the Canary Islands is proposed. ESA

N91-18933# Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany, F.R.).
INTRODUCTION TO METEORITICS
Elmar K. Jessberger *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 73-76 (For primary document see N91-18922 10-90)
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An introduction to the field of meteoritics is presented. A classification of meteorites which provides genetic links between individual rocks is outlined. The global history of meteorites is outlined with emphasis on early solar system processes. The need to support meteoritic research is stressed. Meteorites are identified as being the prime source of information about the precursor material of our solar system, the physicochemical conditions during the formation of the solar system as well as the sequence and duration of all the processes involved in the formation of the solar system. ESA

N91-18934# Paris VII Univ. (France). Groupe de Physique des Solides.
INFRARED SPECTROSCOPY OF A CARBON EXTRACT FROM THE ORGUEIL METEORITE
P. Ehrenfreund, F. Robert, and L. dHendecourt *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 77-80 (For primary document see N91-18922 10-90)
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The three micro spectrum on the galactic center source IRS 7 is compared to a spectrum obtained on the deuterium rich organic polymer extracted from the Orgueil carbonaceous meteorite. The almost perfect match between the two spectra in the 3.4 micrometer region suggests that the chemical composition of the interstellar organic matter resembles that of the meteoritic polymer. The molecular structure of this matter from Orgueil is discussed in comparison with terrestrial kerogens. The fraction of cosmic carbon in this interstellar organic grain material can be calculated by assuming that the carbonaceous extract has the same C/H ratio as the interstellar molecules near IRS 7. ESA

N91-18935# Institut d'Astrophysique, Paris (France).
THE INNER PART OF THE PROTOPLANETARY DISK AROUND BETA PICTORIS
Herve Beust, Alfred Vidal-Madjar, Roger Ferlet, and Anne-Marie Lagrange-Henri (European Southern Observatory, Garching, Germany, F.R.) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 81-86 (For primary document see N91-18922 10-90)
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The IRAS (Infrared Astronomy Satellite) star Beta Pictoris is still the only star detected which has a disk made of both dust and gas. Spectroscopic observations of Beta Pictoris reveal that some metallic absorption lines present redshifted additional components which strongly vary with time. This is interpreted as being the result of the infall of small evaporating cometary like bodies towards the star. Numerical simulations of such infalling bodies are able to reproduce quite faithfully the observed behavior of some metallic ions. New observations presenting previously unobserved features are reproduced by the same model, with only small changes affecting a few parameters. The observed results are considered to be the consequence of the presence of an eventual planetary body somewhere in the disk, the orbit of which is highly elliptical. ESA

N91-18936# Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany, F.R.).
COAGULATION OF PROTOPLANETARY DUST
J. Blum *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 87-92 (For primary document see N91-18922 10-90)
(Grants DFG-lg-3/13; DFG-lg-3/13-2; DFG-lg-3/13-3)
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An experimental setup developed to investigate collisional processes between protoplanetary dust particles is described. The experiments are carried out with fluffy agglomerates in the velocity region from 0.27 to 3.3 m/s. The experimental results show that three different issues can be distinguished; these are coagulation, restitution, and fragmentation. To better understand the physics of low velocity collisions of fluffy agglomerates, a theoretical model is developed taking into consideration the high deformability of the agglomerates, as well as attractive van der Waals forces between colliding particles. Extrapolation of the model allows predictions of the collisional behavior of icy or stony agglomerates to be made. ESA

N91-18937# Leningrad Univ. Observatory (USSR).
INFLUENCE OF DISSIPATIVE PROCESSES ON THE RESONANCES IN PLANETARY SYSTEMS
J. P. Anosova and V. V. Orlov *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 93-96 (For primary document see N91-18922 10-90)
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Some effects of dissipative processes to the resonances in three body planetary systems are considered. The system Sun-Jupiter-Saturn is studied. A dissipative factor is taken into account by considering the fourth body. Two cases are investigated: a connected system of four bodies, and the hyperbolic encounters of the fourth body and triple. In the second case the range of resonance deviation is rather more than in the first case. In the first case some tendency to a resonance is observed. ESA

N91-18938# Warsaw Univ. (Poland). Inst. of Geophysics.
COMPACTION OF THE ICY/ROCKY GRANULAR MIXTURES AND THE PHYSICS OF THE ICY SATELLITES
J. Leliwa-Kopystynski *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 97-102 (For primary document see N91-18922 10-90)
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The formation and evolution of the icy satellites of the giant

planets are discussed. The post formation satellite material is supposed to be a porous icy/rocky regolith. It is evolving due to self compaction at different temperature conditions. The icy/rocky granular samples are compacted within a piston-cylinder system at constant pressure from 2.2 to 17.7 MPa and at different temperatures from 262 to less than 140 K. In another series of experiments the pressure applied ranges from 80 to 820 MPa. The temperature is maintained at 213 K. The results concerning porosity decrease rate show that porosity within the deep interior of the satellites can survive until present time. ESA

N91-18939# Paris VI Univ. (France). Service d'Aeronomie.
COMETS AND THEIR EVOLUTION IN THE SOLAR SYSTEM
A. Chantal Levasseur-Regourd *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 105-111 (For primary document see N91-18922 10-90)
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In-situ and remote studies of comets are described. Results of these studies suggest that the chemical composition of cometary nuclei is similar to that of the interstellar medium. The crust of a comet nucleus is deemed to be dark and porous. The dust grains released in a coma are considered to be a mixture of submicron particles glued together by various polymers. Many different scenarios of cometary evolution are presented. Infrared observations of the IRAS (Infrared Astronomy Satellite) spacecraft confirm the heterogeneity of cometary trails and asteroidal bands. ESA

N91-18940# Hawaii Univ., Honolulu. Inst. for Astronomy.
FAR-IR AND SUBMILLIMETER RADIATION FROM COMETARY AND CIRCUMSTELLAR DUST **c93**
David C. Jewitt *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 113-120 (For primary document see N91-18922 10-90)
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An introduction to the emergent fields of cometary and stellar submillimeter astronomy is presented. Cometary and circumstellar dust grains may share a common origin in the accretion disks of pre-main sequence stars. Far IR and submillimeter radiation from these grains are used to infer basic characteristics of the dust. Long wavelength measurements of comets and circumstellar dust clouds are discussed. The problems inherent in their interpretation are reviewed. ESA

N91-18941# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Astronomie.
CN JETS AS PROGENITORS OF CN SHELLS IN THE COMA OF COMET P/HALLEY
Rita Schulz and Wolfhard Schlosser *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 121-125 (For primary document see N91-18922 10-90)
(Grant DFG-Schm-160/37-1)
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Strong evidence for a connection between CN (cyanide) jets and CN shells in the coma of comet P/Halley is found on digitized CN photographs. At radii of about 80,000 km the transition between jets and shells can be localized by image processing methods. One shell originates from two opposite jets which merge together around the nucleus. This is dynamically impossible for CN jets being directly ejected from a spatially confined source of CN on the nucleus. In such a case, particles would have a preferential direction away from the nucleus and there are no processes by which this direction could be changed. The transition between jets and shells indicates that the CN is produced by secondary sources. There is further evidence that these sources are CHON particles. ESA

N91-18942# Observatoire de Paris-Meudon (France). Dept. de Recherches Spatiales.
EARLY CONDITIONS AND PROCESSES IN THE OUTER SOLAR SYSTEM
Therese Encrenaz *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 127-137 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Study of the chemical composition of comets, giant planets and Titan is discussed. The composition of the primordial solar nebula at large heliocentric distances and the physicochemical processes involved in their formation and evolution are studied. Elemental and isotopic abundance ratios are used as tools in studying these formation and evolution processes. The importance of data gained on ISO (Infrared Space Observatory), Galileo, Cassini, CRAF (Comet Rendezvous Asteroid Flyby) and Rosetta missions in furthering better understanding of these processes is stressed. ESA

N91-18943# Leiden Univ. (Netherlands). Lab. of Astrophysics.
THE DUST IN THE COMA OF COMET HALLEY
Joniek I. Hage and J. Mayo Greenberg *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 139-142 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

The interstellar dust model of comets is numerically worked out to satisfy several basic constraints provided by observations of Comet Halley and to derive the porosity of coma dust. The observational constraints are the strengths of the 3.4 and 9.7 micrometer emission bands, the ratio of silicates to organic materials, and the mass distribution of the dust. The results indicate that coma dust has a porosity between 0.93 and 0.975. Preliminary calculations concerning the observed linear polarization of comet Halley are presented. ESA

N91-18944# Observatoire de Paris-Meudon (France).
OBSERVATIONS OF PARENT MOLECULES IN COMETS P/BRORSEN-METCALF (1989o), AUSTIN (1989cl) AND LEVY (1990c) AT MILLIMETRE WAVELENGTHS: HCN, H2S, H2CO AND CH3OH
D. Bockelee-Morvan, J. Crovisier, P. Colom, D. Despois, and G. Paubert (Instituto de Radioastronomia, Granada, Spain) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 143-148 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Millimeter observations conducted with a radio astronomy 30 m telescope on comets P/Brorsen-Metcalf (1989o) on September 1989, Austin (1989cl) on April and May 1990, and Levy (1990c) on August 1990 at Pico Veleta in Spain, are discussed. Two species are detected for the first time in a comet: hydrogen sulfide (H2S) and methanol (CH3OH). Rotational transitions of HCN and H2CO are also detected. Preliminary estimates of molecular abundances are presented. Searches for SO2, OCS, H2CS and HC3N, although negative, give significant constraints on the abundances of these molecules. These observations may help to resolve whether comets are formed from unaltered interstellar material. ESA

N91-18945# Paris Univ., Val de Marne (France). Lab. de Physico-Chimie de l'Environnement.
PREBIOTIC CHEMISTRY IN THE SOLAR SYSTEM
Francois Raulin *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 151-157 (For primary document see N91-18922 10-90)
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Forty years of experimental studies in prebiotic chemistry are summarized. Most of the building blocks of the living systems have been synthesized in conditions plausible to conditions found

on the primitive Earth. The starting ingredients belong to two complementary classes: volatile organics, and their non volatile oligomers. They may have been formed in the atmosphere on the primitive Earth and/or imported by extraterrestrial sources. Organic molecules are found in meteorites, comets, in the giant planets and several of their satellites. Again this chemistry presents two complementary aspects. With a dense reduced atmosphere rich in organic compounds in gas and aerosol phases, Titan appears to be a natural laboratory for studying prebiotic chemistry on a planetary scale. ESA

N91-18946*# Arizona Univ., Tucson. Lunar and Planetary Lab.
EVOLUTION OF THE ATMOSPHERE AND SURFACE OF TITAN **c91**
Jonathan I. Lunine *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 159-165 (For primary document see N91-18922 10-90)
(Grant NAGw-1039)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Present understanding of the surface and atmosphere of Saturn's moon Titan indicates that methane in the stratosphere is photolytically converted to higher hydrocarbons at a rate such that a kilometer deep layer of byproducts has accumulated over the age of the solar system. Many of these byproducts, stable as liquids under current conditions, may be part of a widespread, even global, hydrocarbon-methane-nitrogen ocean. The interaction of this ocean with the atmosphere, together with the progressive stratospheric destruction of methane, may have driven a climatic evolution over geologic time which has left its mark in the bedrock, ocean and atmosphere of this unique world. The current state of understanding of these processes is reviewed. The record of surface atmosphere evolution may be found in the ice crust morphology, composition of any surface oceans, and the atmospheric abundances of deuterated species. In each of these areas key observations will be made by instrument complement aboard the ESA/NASA Huygens probe and Cassini orbiter. ESA

N91-18947# Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse du CNRS, Orsay (France).
C-RICH MICROMETEORITES ON THE EARLY EARTH AND ICY PLANETARY BODIES
M. Maurette, B. Beccard, Ph. Bonny, A. Brack, M. Christophe, and P. Veyssiere (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 167-172 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

The analysis of about 200 mg of 50 to 100 microgram size dust particles extracted from 100 tons of Antarctic blue ice is reported. This dust constitutes the purest and the best preserved source of giant Unmelted Chondritic Micrometeorites (UMCs) recovered from terrestrial sediments. Both the bulk composition of UMCs and their crystal chemistry indicate that at least 95 percent of them are relative to primitive unequilibrated meteorites. They are mostly composed of porous aggregates of submicronsize grains, that contain substituted aromatic organic compounds. UMCs might have functioned as minicenters of prebiotic synthesis on the early Earth. ESA

N91-18948# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Astronomie.
DISTANCE DETERMINATION OF DARK CLOUDS **c89**
Joachim A. Stuewe *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 175-178 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

A new distance determination method for dark clouds is described. The use of different tools in the course of this reduction scheme allows the consistency of the method to be checked. The procedure is applied in three different forms to the same dark cloud. Crosschecking the results shows that the inner accuracy of the method is in the range of 15 percent. ESA

N91-18949# Universidad Nacional Autonoma de Mexico, Villa Obregon. Inst. de Astronomia.
VLA OBSERVATIONS OF AMMONIA IN HERBIG-HARO 1-2 **c89**
L. F. Rodriguez, J. Canto, J. M. Torrelles, G. Anglada, and P. T. P. Ho (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 179-181 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Very Large Array (VLA) observations of the (1,1) and (2,2) transitions of ammonia at 1.3 cm made toward VLA 1, the exciting source of the Herbig-Haro 1-2 system are presented. The morphology of the dense gas resembles an X-shaped structure, centered on VLA 1 with its waist aligned parallel to the bipolar outflow axis (which is in the north west-south east direction). There is radial velocity difference of about 2 km/s between the north west and south east halves of the X shaped structure, with the north west half being blueshifted with respect to the south east half. The relationship of this structure (with a radius of 10,000 AU) with a small scale (100 AU) circumstellar disk that is believed to surround VLA 1 is discussed. ESA

N91-18950# Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
TEN MICRON IMAGING OF COMET AUSTIN
P. O. Lagage, S. Remy, and F. Sibille (Observatoire de Lyon, France) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 183-185 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Images of comet Austin, in the 8 to 13 micrometer broadband filter, were obtained at the 3.6 m Canada-France-Hawaii Telescope on 1990 May 6.6 UT, using the C 10 micrometer camera. These images provide information on the dust distribution in the inner coma up to 4000 km from the nucleus, with a spatial resolution of 250 km (angular resolution per pixel: 0.8 arc s). A preliminary analysis of the comet morphology does not indicate deviation from a symmetrical geometry. The surface brightness has a pixel peak of 1.5 Jy and a radial distribution compatible with a 1/d law, for a beam diameter ranging from 1 to 24 arc s. Some indication of a steepening of the distribution at higher distances can be inferred from the data. ESA

N91-18951# Physical Research Lab., Ahmedabad (India).
CIRCUMSTELLAR DUST IN VEGA-LIKE STARS: A DETAILED ANALYSIS OF IRAS OBSERVATIONS
D. B. Vaidya and B. G. Anandarao *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 187-189 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Infrared Astronomical Satellite (IRAS) data on fourteen main sequence stars showing large infrared excess in 60 micrometers (like Vega) is analyzed. Using a radiative model, the dust shell temperature, angular sizes and dust masses are determined. For all the stars, except Beta Pic, the dust temperatures are found to be (30 + or - 5) K. For Beta Pic the dust shell temperature is found to be (45 + or -5) K AU. For most of the other stars the dust shells are situated between 100 to 1000 AU. The dust masses are in the range 0.001 to 0.00001 globular cluster mass. Calculations show that the circumstellar dust grain sizes for these stars are less than or approximately equal to 1 micrometer. ESA

N91-18952*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IMAGING HIGH-RESOLUTION SPECTROSCOPY IN THE THERMAL INFRARED FOR PLANETARY ATMOSPHERE STUDIES **c89**
Guenter R. Wiedemann (National Academy of Sciences - National Research Council, Greenbelt, MD.) and Donald E. Jennings *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 191-192 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Imaging high resolution infrared spectroscopy is a new approach to planetary atmosphere research. Jovian infrared hydrocarbon lines, formed above the tropospheric cloud layers, are ideal for upper atmospheric studies. High spectral resolution yields altitude information, as the cores of strong lines probe the high stratospheric layers. Simultaneous spatial and spectral observations, possible with 2-D detector arrays, provide global vertical and horizontal information. Previous studies have used single detector Fourier spectrometers with limited sensitivity. A new IR echelle spectrometer with a 2-D detector array developed for imaging high resolution spectroscopy with high sensitivity is discussed. ESA

N91-18953# Leiden Univ. (Netherlands). Lab. of Astrophysics.
EVAPORATION OF H2O-CO2-CH4-CO ICE AND ITS IMPLICATION FOR THE EVOLUTION OF ICE GRAINS
A. Kouchi and T. Kuroda (Hokkaido Univ., Sapporo, Japan) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 193-196 Sponsored in part by Japanese Ministry of Education, Science and Culture, and Yamada Science Foundation (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Evaporation of H2O-CO2-CH4-CO ice is investigated using mass spectroscopy and electron diffraction. The ice condensed at 10 K is a mixture of amorphous CO (a-CO), a-CH4, a-CO2 and a-H2O, about 1/3 of the CO and 1/2 of the CO2 are adsorbed on a-H2O. The residual CO and CH4 are included in a-CO2 and a-H2O as impurities and residual CO2 in a-H2O. When the ice mixture is warmed, trapped molecules evaporate in ten distinct temperature ranges. CO and CH4 trapped in CO2 evaporate at temperatures between 50 and 90 K, and increase with increasing CO2/H2O at 10 K. The CO/H2O ratios in the ice mixture at around 45 K are between 0.07 to 0.13, and are higher than those in H2O-CO ice (0.01 to 0.04). Estimation of nebular temperature based on the evaporation experiments on H2O-CO ice should therefore be corrected. ESA

N91-18954# Cologne Univ. (Germany, F.R.). Abt. Nuklearchemie.
LABORATORY STUDIES ON TIME DEPENDENT PARTICLE EMISSION FROM COMETARY ANALOGUES
Gabriele Koelzer, Harald Kohl, Klaus Thiel, and Eberhard Gruen (Max-Planck-Inst. fuer Kernphysik, Heidelberg, Germany, F.R.) *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 197-201 Sponsored by DFG (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Time dependent behavior of ice/dust/particle emission from cometary analog surfaces under space conditions is experimentally studied by different instrumental techniques in the comet simulation project. Results from time resolved collector measurements, signals from evaporating particles and piezoceramic acoustic detectors are correlated with the heating of the sample surface by irradiation with 1.16 solar constants. It is shown that emission of almost pure ice particles has its highest activity in the first moments of irradiation. In the following 145 minutes it rapidly decreases. When the surface temperature has reached about 300 K, the emission of mineral ice particles starts. Highest activity is measured after 30 to 50 minutes of irradiation. The decay of this activity is much slower than that of the ice particles. The emission of different particles and increasing surface temperature are correlated with the formation of a dust mantle. ESA

N91-18955*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 2.5 TO 5.0 MICROMETER SPECTRAL OF IO: EVIDENCE FOR H2S AND H2O FROZEN IN SO2 **c89**
F. Salama, L. J. Allamandola, F. C. Witteborn, D. P. Cruikshank, S. A. Sandford, and J. D. Bregman *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 203-208 (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Analysis of the 2.5 to 5.0 micrometer spectra of Io using detailed laboratory studies of plausible surface ices is described. The results show that Io's surface most likely contains H2S and H2O mixed with SO2. The 3.85 and 3.91 micrometer bands in the Io spectra can be assigned to the v sub 1 fundamental mode in H2S clusters and isolated molecules in SO2 ice. The 2.97 and 3.15 micrometer bands coincide with the v sub 3 and v sub 1 vibrations of clusters of H2O molecules complexed with SO2. The observations are well matched by the spectra of SO2 ices containing 3 percent H2S and 0.1 percent H2O which has been formed by condensation onto a 100 K surface. The shifts and splitting of the absorption bands seen in the Io spectrum and the fact that solid H2S is observed in the surface material of Io at temperature and pressure conditions above its sublimation point can only be explained by the mixed molecular ices model. ESA

N91-18956# Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany, F.R.).
RADIO AND INFRA-RED OBSERVATIONS OF COMET AUSTIN 1989CI
S. Chakaveh, W. Dent, C. D. Kaminski (Hawaii Univ., Honolulu.), and Elmar K. Jessberger *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 209-211 Sponsored by DFG (For primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

Comet Austin was observed at 1100 and 1300 microns using JCMT (James Clerk Maxwell Telescope) and parallel 10 micron photometry was performed on the comet using the NASA IRTF telescope at Mauna Kea. For millimeter observations point to point photometry maps were generated and these were used in conjunction with the 10 micron measurements, to determine various physical parameters such as the equilibrium temperature, dust production rate and gas to dust ratio for this comet. Using the millimeter maps the number of larger cometary dust grains (greater than 100 micros) is estimated. When this is compared to the total number of dust particles in the coma it is found that most of the mass lies within these particle ranges. ESA

N91-18957# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.).
PROTOPLANETARY DISKS: OBSERVATIONS AND PHYSICAL PROCESSES
G. E. Morfill and M. Sterzik *In* ESA, Formation of Stars and Planets and the Evolution of the Solar System Nov. 1990 p 219-227 (For primary document see N91-18922 10-90)
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Observations of disks around young premain stars are reviewed. A summary of disk properties is presented. The disks are the most likely environment for planet formation. The observations are interpreted in the context of steady accretion disk models. Observed departures from such a standard model are discussed in terms of different physical processes as well as time dependence. The processes leading to electrical discharges in the protoplanetary disk are described. ESA

N91-18958# Los Alamos National Lab., NM.
SUBSTORM FEATURES IN MHD (MAGNETOHYDRODYNAMICS) SIMULATIONS OF MAGNETOTAIL DYNAMICS
J. Birn and M. Hesse 1990 38 p Presented at the Chapman Conference on Magnetospheric Substorms, Hakone, Japan, 3-7 Sep. 1990
(Contract W-7405-eng-36)
(DE91-007407; LA-UR-91-220; CONF-9009109-2) Avail: NTIS HC/MF A03

We present a review and extended analysis of characteristic results from our nonideal three-dimensional MHD simulations of unstable magnetotail evolution, which develops without the necessity of external driving or prescribed localization on nonideal effects. These modes involve magnetic reconnection at a near-Earth site in the tail, consistent with the near-Earth neutral line model of substorms. The evolution tailward of the reconnection site is characterized by plasmoid formation and ejection into the far tail, plasma sheet thinning between the near-Earth neutral line (X line) and the departing plasmoid, and fast tailward flow, which occupies large sections of the plasma sheet at larger distance from the X line, while it occurs only in very limited space and time sections close to the X line. The region earthward of the X line is characterized by dipolarization, propagating from midnight toward the flank regions and, perhaps, tailward. It is associated with the signatures of the substorm current wedge: reduction and diversion of cross-tail current from a region surrounding the reconnection site and increase of Region 1 type field-aligned currents. A mapping of these currents to the Earth on the basis of an empirical magnetic field model shows good agreement of the mapped current system with the observed Region 1 field-aligned current system and its substorm associated changes, including also a nightward and equatorward shift of the peaks of the field-aligned current density. The evolution of the mappings of the boundaries of the closed field line region bears strong resemblance to the formation and expansion of the auroral bulge. The consistency of all of these details with observed substorm features strongly supports the idea that substorm evolution in the tail is that of a large scale nonideal instability. DOE

N91-18316*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
COMPRESSED/RECONSTRUCTED TEST IMAGES FOR CRAF/CASSINI
S. Dolinar, K.-M. Cheung, I. Onyszchuk, F. Pollara, and S. Arnold *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1991 p 88-97 (For primary document see N91-18308 10-32)
Avail: NTIS HC/MF A12 CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N91-18959*# Southwest Research Inst., San Antonio, TX.
HIGH MASS RESOLUTION, HIGH ANGULAR ACCEPTANCE TIME-OF-FLIGHT MASS SPECTROSCOPY FOR PLANETARY MISSIONS UNDER THE PLANETARY INSTRUMENT DEFINITION AND DEVELOPMENT PROGRAM (PIDDP) Final Report, 1 Jan. 1988 - 28 Feb. 1991
David T. Young 28 Feb. 1991 87 p
(Contract NAGw-1286; W-7405-eng-36; SwRI Proj. 15-2351)
(NASA-CR-187912; NAS 1.26:187912) Avail: NTIS HC/MF A05 CSCL 03B

This final report covers three years and several phases of work in which instrumentation for the Planetary Instrument Definition and Development Program (PIDDP) were successfully developed. There were two main thrusts to this research: (1) to develop and test methods for electrostatically scanning detector field-of-views, and (2) to improve the mass resolution of plasma mass spectrometers to M/delta M approximately 25, their field-of-view (FOV) to 360 degrees, and their E-range to cover approximately 1 eV to 50 keV. Prototypes of two different approaches to electrostatic scanning were built and tested. The Isochronous time-of-flight (TOF) and the linear electric field 3D TOF devices were examined. Author

N91-18960*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MERCURY ORBITER: REPORT OF THE SCIENCE WORKING TEAM
John W. Belcher, James A. Slavin, Thomas P. Armstrong, Robert W. Farquhar, Syun I. Akasofu, Daniel N. Baker, Cynthia A. Cattell, Andrew F. Cheng, Edward L. Chupp, and Pamela E. Clark (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) et al Washington Feb. 1991 134 p Prepared in cooperation with RAND Corp., Santa Monica, CA; LANL, NM; Iowa Univ., Iowa City; Nagoya Univ., Japan; Rome Univ., Italy; Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Fed. Republic of Germany; Washington Univ., Seattle; LMSC, Palo Alto, CA.; California Univ., Los Angeles (NASA-TM-4255; REPT-91B00046; NAS 1.15:4255) Avail: NTIS HC/MF A07 CSCL 03B

The results are presented of the Mercury Orbiter Science Working Team which held three workshops in 1988 to 1989 under the auspices of the Space Physics and Planetary Exploration Divisions of NASA Headquarters. Spacecraft engineering and mission design studies at the Jet Propulsion Lab were conducted in parallel with this effort and are detailed elsewhere. The findings of the engineering study, summarized herein, indicate that spin stabilized spacecraft carrying comprehensive particles and fields experiments and key planetology instruments in high elliptical orbits can survive and function in Mercury orbit without costly sun shields and active cooling systems. Author

N91-18125*# California Univ., Los Angeles.
DESIGN OF A SCIENTIFIC PROBE FOR OBTAINING MARS SURFACE MATERIAL
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 27-33 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

N91-18129*# Florida Agricultural and Mechanical Univ., Tallahassee.
CONCEPTUAL SECOND-GENERATION LUNAR EQUIPMENT
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 53-54 Prepared in cooperation with Florida State Univ., Tallahassee (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

N91-18134*# Houston Univ., TX. Coll. of Architecture.
IN-SITU RESOURCE UTILIZATION IN THE DESIGN OF ADVANCED LUNAR FACILITIES
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 79-87 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 03B

N91-18924# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CASSINI: A MISSION TO SATURN AND TITAN
Jean-Pierre Lebreton and Dennis Matson *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 7-12 (For primary document see N91-18922 10-90)
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N91-18946*# Arizona Univ., Tucson. Lunar and Planetary Lab.
EVOLUTION OF THE ATMOSPHERE AND SURFACE OF TITAN
Jonathan I. Lunine *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 159-165 (For primary document see N91-18922 10-90)

(Grant NAGw-1039)
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92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N91-18961# Midwest Research Inst., Golden, CO. Solar Technical Information Program.
INSOLATION DATA MANUAL: LONG-TERM MONTHLY AVERAGES OF SOLAR RADIATION, TEMPERATURE, DEGREE-DAYS, AND GLOBAL K(SUB T) FOR 248 NATIONAL WEATHER SERVICE STATIONS AND DIRECT NORMAL SOLAR RADIATION DATA MANUAL: LONG-TERM, MONTHLY MEAN, DAILY TOTALS FOR 235 NATIONAL WEATHER SERVICE STATIONS
Jul. 1990 364 p
(Contract DE-AC02-83CH-10093)
(DE90-000353; SERI/TP-220-3880) Avail: NTIS HC/MF A16

The Insolation Data Manual presents monthly averaged data which describes the availability of solar radiation at 248 National Weather Service (NWS) stations, principally in the United States. Monthly and annual average daily insolation and temperature values have been computed from a base of 24 to 25 years of data, generally from 1952 to 1975, and listed for each location. Insolation values represent monthly average daily totals of global radiation on a horizontal surface and are depicted using the three units of measurement: kJ/sq m per day, Btu/sq ft per day and langleys per day. Average daily maximum, minimum and monthly temperatures are provided for most locations in both Celsius and Fahrenheit. Heating and cooling degree-days were computed relative to a base of 18.3 C (65 F). For each station, global K(sub T) (cloudiness index) values were calculated on a monthly and annual basis. Global K(sub T) is an index of cloudiness and indicates fractional transmittance of horizontal radiation, from the top of the atmosphere to the earth's surface. The second section of this volume presents long-term monthly and annual averages of direct normal solar radiation for 235 NWS stations, including a discussion of the basic derivation process. This effort is in response to a generally recognized need for reliable direct normal data and the recent availability of 23 years of hourly averages for 235 stations. The relative inaccessibility of these data on microfiche further justifies reproducing at least the long-term averages in a useful format. In addition to a definition of terms and an overview of the ADIPA model, a discussion of model validation results is presented. DOE

N91-18962# Midwest Research Inst., Golden, CO.
SOLAR RADIATION RESOURCE ASSESSMENT: AN OVERVIEW
Nov. 1990 27 p
(Contract DE-AC02-83CH-10093)
(DE91-002104; SERI/SP-220-3978) Avail: NTIS HC/MF A03

The following topics are addressed: (1) the importance of solar radiation assessment; (2) understanding the basics about solar radiation and resource assessment; (3) the solar radiation resource assessment project; and (4) future activities. The appendices include the Federal role in solar radiation resource assessment; U.S. solar radiation data sets; and a bibliography of Solar Energy Research Institute (SERI) publications. K.S.

N91-18963# European Space Agency, Paris (France).
KEY DATA ON PARTICIPATING PROJECTS: THE SOLAR-TERRESTRIAL SCIENCE PROJECT OF THE INTER-AGENCY CONSULTATIVE GROUP FOR SPACE SCIENCE (IACG)
R. Reinhard, comp. and B. Battrick, comp. Nov. 1990 126 p
(ESA-SP-1107; ISSN-0379-6566; ETN-91-98620) Copyright Avail: NTIS HC/MF A07; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The scientific objectives, payloads, and key spacecraft and mission or orbit data for each project are given with a drawing of each spacecraft and a plot of its orbit. Among the missions included are: (1) the Geotail mission, whose objective is to study the dynamics of the Earth magnetotail over a wide range of distances extending from the near Earth region to the distant tail; (2) the Wind mission, whose objective is to investigate solar wind input properties such as plasma waves on energetic particles; (3) the Polar mission, whose objective is to investigate energy input to the ionospheric region through the dayside cusp and to study the characteristics of the auroral plasma acceleration regions; and (4) the Galileo mission, whose objective is to investigate the chemical composition and physical state of Jupiter atmosphere. ESA

N91-18964# Los Alamos National Lab., NM.
STATUS OF SOLAR NEUTRINO EXPERIMENTS
E. W. Beier, R. Davis, Jr., S. B. Kim, S. R. Elliott, and N. Jelley (Oxford Univ., England) 1990 12 p Presented at the 12th PANIC International Conference on Particles and Nuclei, Cambridge, 24-29 Jun. 1990
(Contract W-7405-eng-36)
(DE91-007468; LA-UR-91-237; CONF-900601-24) Avail: NTIS HC/MF A03

A summary of the status of four solar neutrino experiments is presented. The Homestake (sup 37)Cl data are presented and the possible time dependence of the data is addressed. Data from 1040 days of operation of the Kamiokande II detector are presented next. The status of the (sup 71)Ga experiment in the Baksan Neutrino Observatory, which has operated for a short time, is discussed. The summary concludes with a discussion of the status of the Sudbury Neutrino Observatory, which has been under construction since the beginning of 1990. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N91-18965# Lawrence Livermore National Lab., CA.
ANALYSIS OF GAMMA-RAY BURST ENERGY SPECTRA Final Report, 15 Jan. - 31 Aug. 1990
Kevin Hurley and Charles D. Dermer (California Univ., Berkeley.) 1990 3 p
(Contract W-7405-eng-48)
(DE91-006686; UCRL-CR-105803) Avail: NTIS HC/MF A01

This report summarizes the work carried out under LLNL Contract Number B108527, subcontracted by the Regents of the University of California at Berkeley. The research carried out under this contract includes assisting in the data analysis for the Prognoz-9 mission, linking results of the computer codes to the Prognoz-9 data library in order to study the spectral shape and evolution of cosmic gamma-ray burst energy spectra, and using the results of this study to help to determine or constrain the physical conditions at the gamma-ray bursts sources. The results of this work led to several publications that have shed considerable insight into the gamma-ray burst mystery, and gives a new diagnostic for determining the nature of gamma-ray burst sources. The outcome of this work also provides a new spectral form for studying the temporal evolution and spectral behavior of gamma-ray bursts. DOE

N91-18940# Hawaii Univ., Honolulu. Inst. for Astronomy.
FAR-IR AND SUBMILLIMETER RADIATION FROM COMETARY AND CIRCUMSTELLAR DUST
David C. Jewitt *In* ESA, Formation of Stars and Planets, and the Evolution of the Solar System Nov. 1990 p 113-120 (For

primary document see N91-18922 10-90)
Copyright Avail: NTIS HC/MF A10; EPD, ESTEC, Noordwijk, Netherlands, HC 60 Dutch guilders

N91-18984*# Mankato State Coll., MN. Dept. of Mathematics, Astronomy, and Statistics.
BATSE SOFTWARE FOR THE ANALYSIS OF THE GAMMA RAY BURST SPATIAL DISTRIBUTION
Jon Hakkila *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 03B

N91-18992*# Alabama Univ., University. Dept. of Physics and Astronomy.
GAMMA-RAY BURSTS: AN OVERVIEW
John Patrick Lestrade *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-008-021)
Avail: NTIS HC/MF A16 CSCL 03B

99 GENERAL

N91-18966*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RESEARCH AND TECHNOLOGY 1990, LANGLEY RESEARCH CENTER
Feb. 1991 247 p Original contains color illustrations
(NASA-TM-4243; L-16860; NAS 1.15:4243) Avail: NTIS HC/MF A11; 28 functional color pages CSCL 05D

The mission of NASA-Langley is to increase the knowledge and capability of the U.S. in a full range of aeronautics disciplines and in selected space disciplines. This mission will be executed by performing innovative research relevant to national needs and agency goals, transferring technology to users in a timely manner, and providing development support to other U.S. government agencies, industry, and other NASA centers. Highlights are presented of the major accomplishments and applications that were made during the past year. The highlights illustrate both the broad range of the research and technology activitives at NASA-Langley and the contributions of this work toward maintaining U.S. leadership in aeronautics and space research. Author

N91-18967*# Alabama Univ., Tuscaloosa.
RESEARCH REPORTS: 1990 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
L. Michael Freeman, ed., Charles R. Chappell, ed., Frank Six, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.), and Gerald R. Karr, ed. Oct. 1990 370 p Fellowship program held in Huntsville, AL, 4 Jun. - 10 Aug. 1990 Prepared in cooperation with Alabama Univ., Huntsville
(Grant NGT-01-002-099)
(NASA-CR-184044; NAS 1.26:184044) Avail: NTIS HC/MF A16 CSCL 05B

Reports on the research projects performed under the NASA/ASEE Summer Faculty Fellowship Program are presented. The program was conducted by The University of Alabama and MSFC during the period from June 4, 1990 through August 10, 1990. Some of the topics covered include: (1) Space Shuttles; (2) Space Station Freedom; (3) information systems; (4) materials and processes; (4) Space Shuttle main engine; (5) aerospace sciences; (6) mathematical models; (7) mission operations; (8) systems analysis and integration; (9) systems control; (10) structures and dynamics; (11) aerospace safety; and (12) remote sensing For individual titles, see N91-18968 through N91-19021.

N91-18968*# Puerto Rico Univ., Rio Piedras. Dept. of Physics R. U. M.
EFFECTS OF ANTIMONY SUBSTITUTION ON BISMUTH BASED SUPERCONDUCTORS **c76**
Alfonso Barrientos *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 12 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20F

The effect of Sb substitution and simultaneous substitution of Pb and Sb on the superconducting transition temperatures in the BiSrCaCuO system is investigated. The 2:2:2:3 phase is of particular interest since any small increase in the transition temperature could be of great interest. More that 90 different samples were prepared based on 2:2:2:3 stoichiometry in the BiSrCaCuO system. After this preliminary attempt, four different families of samples were investigated. In the first family of samples, Bi was substituted by Sb to form Bi(1.9)Sb(0.1)Sr2Ca2Cu3O(y). The second group of samples were prepared by simultaneous addition of Pb and Sb with nominal composition Bi(1.8)Pb(0.1)Sb(0.1)Sr2Ca2Cu3O(y). The third and fourth groups were prepared to determine the effect created when the Pb concentration is increased with the nominal compositions being Bi(1.7)Pb(0.1)Sr2Ca2Cu3O(y) and Bi(1.6)Sb-(0.1)Sr2Ca2Cu3O(y). The results of these investigations are presented with a discussion. Author

N91-18969*# Mississippi State Univ., Mississippi State. Dept. of Physics and Astronomy.
BIAS AND UNCERTAINTY IN THE ABSORPTION EMISSION MEASUREMENT OF ATOMIC SODIUM DENSITY IN THE SSME EXIT PLANE **c20**
Leslie E. Bauman *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

The measurement of atomic sodium concentration in the TTB 019 firing of April 1990 is significant in that it represents the first measurement of density at the exit plane of the space shuttle main engine. The knowledge of the sodium density, combined with the certainty that the exit plane of the plume is optically thin at the sodium D-line wavelengths, provides essential information for evaluation of diagnostic techniques using sodium atoms, such as resonant Doppler velocimetry for temperature, pressure, and velocity through high resolution fluorescent lineshape analysis. The technique used for the sodium atom line transmission (SALT) measurements is that of resonant absorption emission using a hollow cathode lamp as the reference source. Through the use of two-dimensional kinetic (TDK) predictions of temperature and density for the flight engine case and radiative transfer calculations, this line-of-sight spectrally integrated transmission indicates a sodium atom concentration, i.e., mole fraction, of 0.91e-10. The subject of this paper is the assumptions and measurement uncertainties tied into the calculation. Because of the narrow shape of the source emission, the uncertainties in the absorption profile could introduce considerable bias in the measurement. The following were investigated: (1) the inclusion of hyperfine splitting of the D-lines in the calculation; (2) the use of the flight engine predictions of plume temperature and density versus those for the large throat engine; (3) the assumption of a Gaussian, i.e., Doppler, distribution for the source radiance with a temperature of 400 K; (4) the use of atomic collisional shift and width values for the work by Jongerius; and (5) a Doppler shift for a 7 degree outward velocity vector at the plume edge. Also included in the study was the bias introduced by an uncertainty in the measurement of the D1/D2 line ratio in the source. Author

N91-18970*# Alabama A & M Univ., Huntsville. Dept. of Mathematics.
UPDATING AND AUGMENTING NASA SPACELINK ELECTRONIC INFORMATION SYSTEM **c82**
Jean A. Blake *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990

7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05B

NASA's Spacelink is a collection of NASA information and educational materials stored on a computer at the Marshall Space Flight Center (MFSC). It is provided by the NASA Education Affairs Division and is operated by the Public Services and Education Branch of the MFSC Public Affairs Office. It is designed to communicate with a wide variety of computers and modems, especially those most commonly found in classrooms and homes. The system may be accessed by the educators and the public over regular telephone lines. NASA Spacelink is free except for the cost of long distance calls. The material prepared for Spacelink was found to be widespread by teachers and others across the nation and is being used to stimulate students in their quest for excellence. A partial summary of Spacelinks usage is presented.
Author

N91-18971*# Niagra Univ., New York, NY. Dept. of Computer and Information Sciences.
LIGHTNING OBSERVATIONS FROM SPACE SHUTTLE **c47**
William L. Boeck *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990
5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 04B

The experimental program of the Earth Sciences and Applications Division at NASA/MSFC includes development of the Lightning Imaging Sensor (LIS) for the NOAA Earth Observing System (EOS) Polar Platform. The research plan is to use existing lightning information to generate simulated data for the LIS experiment. Navigation algorithms were used to transform pixel locations to latitude and longitude values. The simulated data would then be used to test and develop algorithms for the analysis of LIS data. Individual frames of video imagery obtained from Space Shuttle Missions provide the raw data for the simulation. Individual video frames were digitized to get the pixel locations of lightning flashes. The pixel locations will be used to locate the geographical position of the event. Because of a lack of detailed knowledge of camera orientation with respect to the Space Shuttle, video scenes that contain identifiable city lights were chosen for analysis. A method for locating the payload bay camera axis was developed and tested. Two measurements are needed: the pixel location of the apparent horizon and a timed siting of a known location passing the principal line of the image. Individual video frames were navigated and lightning illuminated clouds were located on the map. Satisfactory agreement in location was achieved for cities and LLP lightning locations. Ground truth measurements were compared to satellite observations. A vertical lightning event was identified on the horizon. Very low frequency (VLF) transmission on this particular occassion shows a strong response to negative cloud to cloud flashes. K.S.

N91-18972*# Alabama Univ., Huntsville. Dept. of Computer Science.
NAVIGATION IN LARGE INFORMATION SPACES REPRESENTED AS HYPERTEXT: A REVIEW OF THE LITERATURE **c82**
Marcus Brown *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990
4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05B

The problem addressed is the failure of information-space navigation tools when the space grows to large. The basic goal is to provide the power of the hypertext interface in such a way as to be most easily comprehensible to the user. It was determined that the optimal structure for information is an overlapping, simplified hierarchy. The hierarchical structure should be made obvious to the user, and many of the non-hierarchical links in the information space should either by eliminated, or should be de-emphasized so that the novice user is not confused by them. Only one of the hierarchies should be very simple. K.S.

N91-18973*# Mississippi State Univ., Mississippi State. Dept. of Mechanical and Nuclear Engineering.
WELDING ARC PLASMA PHYSICS **c75**
Bruce L. Cain *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990
6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20I

The problems of weld quality control and weld process dependability continue to be relevant issues in modern metal welding technology. These become especially important for NASA missions which may require the assembly or repair of larger orbiting platforms using automatic welding techniques. To extend present welding technologies for such applications, NASA/MSFC's Materials and Processes Lab is developing physical models of the arc welding process with the goal of providing both a basis for improved design of weld control systems, and a better understanding of how arc welding variables influence final weld properties. The physics of the plasma arc discharge is reasonably well established in terms of transport processes occurring in the arc column itself, although recourse to sophisticated numerical treatments is normally required to obtain quantitative results. Unfortunately the rigor of these numerical computations often obscures the physics of the underlying model due to its inherent complexity. In contrast, this work has focused on a relatively simple physical model of the arc discharge to describe the gross features observed in welding arcs. Emphasis was placed of deriving analytic expressions for the voltage along the arc axis as a function of known or measurable arc parameters. The model retains the essential physics for a straight polarity, diffusion dominated free burning arc in argon, with major simplifications of collisionless sheaths and simple energy balances at the electrodes. Author

N91-18974*# Stanford Univ., CA. Dept. of Electrical Engineering.
A SATELLITE-GROUND STUDY OF THE DYNAMICS OF THE BULGE REGION OF THE EARTH'S MAGNETOSPHERE **c46**
Donald L. Carpenter *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990
3 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 04A

Data from multiple ground stations and satellites were used to see how the plasmasphere in the dusk sector is modified during magnetic storms. There is clearly some type of erosion process, during which the plasmasphere is diminished in size, and it is believed that the excess plasma is peeled off and carried (convected) away toward the outer boundary of the magnetosphere (the magnetopause). However, very little is know about the physics of the erosion process, and about how the plasmasphere recovers during the quiet periods that follow such disturbances. Case studies from three multiday periods in 1982 produced a number of new findings which are summarized in this two page document.
Author

N91-18975*# Middle Tennessee State Univ., Murfreesboro. Dept. of Mathematics and Statistics.
IS IT POSSIBLE TO IDENTIFY A TREND IN PROBLEM/FAILURE DATA **c38**
Curtis K. Church *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990
5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 14D

One of the major obstacles in identifying and interpreting a trend is the small number of data points. Future trending reports will begin with 1983 data. As the problem/failure data are aggregated by year, there are just seven observations (1983 to 1989) for the 1990 reports. Any statistical inferences with a small amount of data will have a large degree of uncertainty. Consequently, a regression technique approach to identify a trend is limited. Though trend determination by failure mode may be unrealistic, the data may be explored for consistency or stability and the failure rate investigated. Various alternative data analysis

procedures are briefly discussed. Techniques that could be used to explore problem/failure data by failure mode are addressed. The data used are taken from Section One, Space Shuttle Main Engine, of the Calspan Quarterly Report dated April 2, 1990.
Author

N91-18976*# Alabama Univ., Huntsville. Dept. of Computer Science.
NATIONAL LAUNCH STRATEGY VEHICLE DATA MANAGEMENT SYSTEM **c15**
David Cordes *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

The national launch strategy vehicle data management system (NLS/VDMS) was developed as part of the 1990 NASA Summer Faculty Fellowship Program. The system was developed under the guidance of the Engineering Systems Branch of the Information Systems Office, and is intended for use within the Program Development Branch PD34. The NLS/VDMS is an on-line database system that permits the tracking of various launch vehicle configurations within the program development office. The system is designed to permit the definition of new launch vehicles, as well as the ability to display and edit existing launch vehicles. Vehicles can be grouped in logical architectures within the system. Reports generated from this package include vehicle data sheets, architecture data sheets, and vehicle flight rate reports. The topics covered include: (1) system overview; (2) initial system development; (3) supercard hypermedia authoring system; (4) the ORACLE database; and (5) system evaluation. Author

N91-18977*# Southern Univ., Baton Rouge, LA. Dept. of Mechanical Engineering.
A STUDY OF HYDROGEN ENVIRONMENT EFFECTS ON MICROSTRUCTURE PROPERTY BEHAVIOR OF NASA-23 ALLOY AND RELATED ALLOY SYSTEMS **c26**
Ravinder M. Diwan *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

This work is part of the overall advanced main combustion chamber (AMCC) casting characterization program of the Materials and Processes Laboratory of the Marshall Space Flight Center. The influence of hydrogen on the tensile properties and ductility behavior of NASA-23 alloy were analyzed. NASA-23 and other referenced alloys in cast and hipped conditions were solution treated and aged under selected conditions and characterized using optical metallography, scanning electron microscopy, and electron microprobe analysis techniques. The yield strength of NASA-23 is not affected much by hydrogen under tensile tests carried at 5000 psig conditions; however, the ultimate strength and ductility properties are degraded. This implies that the physical mechanisms operating would be related to the plastic deformation process. The fracture surfaces characteristics of NASA-23 specimens tensile tested in hydrogen, helium, and air were also analyzed. These revealed surface cracks around specimen periphery with the fracture surface showing a combination of intergranular and transgranular modes of fracture. It is seen that the specimens charged in hydrogen seem to favor a more brittle fracture mode in comparison to air and helium charged specimens. The AMCC casting characterization program is to be analyzed for their hydrogen behavior. As a result of this program, the basic microstructural factors and fracture characteristics in some cases were analyzed. Author

N91-18978*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
DAMPER BEARING ROTORDYNAMICS **c37**
David A. Elrod *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

High side loads reduce the life of the Space Shuttle Main Engine (SSME) High Pressure Oxygen Turbopump (HPOTP) bearings. High stiffness damper seals were recommended to reduce the loads on the pump and turbine end bearings in the HPOTP. The seals designed for use on the pump end are expected to adequately reduce the bearing loads; the predicted performance of the planned turbine end seal is marginal. An alternative to the suggested turbine end seal design is a damper bearing with radial holes from the pressurized center of the turbopump rotor, feeding a smooth land region between two rough-stator/smooth-rotor annular seals. An analysis was prepared to predict the leakage and rotor dynamic coefficients (stiffness, damping, and added mass) of the damper bearing. Governing equations of the seal analysis modified to model the damper bearing; differences between the upstream conditions of the damper bearing and a typical annular seal; prediction of the damper bearing analysis; and assumptions of the analysis which require further investigation are described. Author

N91-18979*# Alabama Univ., Tuscaloosa. Dept. of Mechanical Engineering.
MECHANICAL DESIGN PROBLEMS ASSOCIATED WITH TURBOPUMP FLUID FILM BEARINGS **c37**
Charles R. Evces *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

Most high speed cryogenic turbopumps for liquid propulsion rocket engines currently use ball or roller contact bearings for rotor support. The operating speeds, loads, clearances, and environments of these pumps combine to make bearing wear a limiting factor on turbopump life. An example is the high pressure oxygen turbopump (HPOTP) used in the Space Shuttle Main Engine (SSME). Although the HPOTP design life is 27,000 seconds at 30,000 rpms, or approximately 50 missions, bearings must currently be replaced after 2 missions. One solution to the bearing wear problem in the HPOTP, as well as in future turbopump designs, is the utilization of fluid film bearings in lieu of continuous contact bearings. Hydrostatic, hydrodynamic, and damping seal bearings are all replacement candidates for contact bearings in rocket engine high speed turbomachinery. These three types of fluid film bearings have different operating characteristics, but they share a common set of mechanical design opportunities and difficulties. Results of research to define some of the mechanical design issues are given. Problems considered include transient strat/stop rub, non-operational rotor support, bearing wear inspection and measurement, and bearing fluid supply route. Emphasis is given to the HPOTP preburner pump (PBP) bearing, but the results are pertinent to high-speed cryogenic turbomachinery in general.
Author

N91-18980*# Auburn Univ., AL. Dept. of Mechanical Engineering.
DISK FLEXIBILITY EFFECTS ON THE ROTORDYNAMICS OF THE SSME HIGH PRESSURE TURBOPUMPS **c37**
George T. Flowers *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13K

Rotordynamical analyses are typically performed using rigid disk models. Studies of rotor models in which the effects of disk flexibility were included indicate that it may be an important effect for many systems. This issue is addressed with respect to the Space Shuttle Main Engine high pressure turbopumps. Finite element analyses were performed for a simplified free-free flexible disk rotor models and the modes and frequencies compared to those of a rigid disk model. Equations were developed to account for disk flexibility in rotordynamical analysis. Simulation studies were conducted to

assess the influence of disk flexibility on the HPOTP. Some recommendations are given as to the importance of disk flexibility and for how this project should proceed. Author

N91-18981*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.

ESTABLISHMENT OF A STRAIN ANALYSIS CAPABILITY USING PHOTOELASTIC COATINGS **c39**

Samuel C. Gambrell, Jr. *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 2 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20K

In accordance with the Research Plan prepared at the beginning of the Fellowship Program, the summer activities consisted of: training the personnel of the Structural Test Division of the Structures and Dynamics Laboratory in the theory and practice of strain analysis using photoelastic coatings; and performing strain analysis using photoelastic coatings on appropriate test articles. In support of these activities, the following actions were taken: (1) equipment and supplies necessary for strain analysis using photoelastic coatings were specified, purchased, and checked out; (2) four engineers were trained in the theory and practice of strain analysis using photoelastic coatings; (3) four technicians were trained in the practice of preparing and applying photoelastic coatings to both curved and flat surfaces; (4) in addition to the final program seminar, three seminars on the fundamentals and use of photoelastic coatings were presented to a total of 43 members of the various laboratories at MSFC; (5) a photoelastic coating was applied to and used in a test of a thrust vector control corner section; (6) to further assist the engineers with the use and understanding of photoelastic coatings, fifteen journal articles were located and copied, and camera settings for photographic fringe patterns were determined and recorded; and (7) two proposals for providing technical assistance in strain analysis at MSFC and testing of selected components/assemblies at the University of Alabama in Tuscaloosa were written for submission to NASA. Author

N91-18982*# Mississippi State Univ., Mississippi State. Dept. of Aerospace Engineering.

MULTI-BLOCKING STRATEGIES FOR THE INS3D INCOMPRESSIBLE NAVIER-STOKES CODE **c34**

Boyd Gatlin *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20D

With the continuing development of bigger and faster supercomputers, computational fluid dynamics (CFD) has become a useful tool for real-world engineering design and analysis. However, the number of grid points necessary to resolve realistic flow fields numerically can easily exceed the memory capacity of available computers. In addition, geometric shapes of flow fields, such as those in the Space Shuttle Main Engine (SSME) power head, may be impossible to fill with continuous grids upon which to obtain numerical solutions to the equations of fluid motion. The solution to this dilemma is simply to decompose the computational domain into subblocks of manageable size. Computer codes that are single-block by construction can be modified to handle multiple blocks, but ad-hoc changes in the FORTRAN have to be made for each geometry treated. For engineering design and analysis, what is needed is generalization so that the blocking arrangement can be specified by the user. INS3D is a computer program for the solution of steady, incompressible flow problems. It is used frequently to solve engineering problems in the CFD Branch at Marshall Space Flight Center. INS3D uses an implicit solution algorithm and the concept of artificial compressibility to provide the necessary coupling between the pressure field and the velocity field. The development of generalized multi-block capability in INS3D is described. Author

N91-18983*# University of Southern Mississippi, Hattiesburg. Dept. of Management Information Systems.

NASA ACCOUNTING AND FINANCIAL INFORMATION SYSTEM (NAFIS): A CRITICAL ASSESSMENT OF THE SYSTEMS DEVELOPMENT METHODOLOGY **c82**

Ernest Preston Goss *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Contract NAS8-37200)
Avail: NTIS HC/MF A16 CSCL 05B

The NASA Accounting and Financial Information System (NAFIS) systems development methodology was examined. The recommendations are briefly outlined. B.G.

N91-18984*# Mankato State Coll., MN. Dept. of Mathematics, Astronomy, and Statistics.

BATSE SOFTWARE FOR THE ANALYSIS OF THE GAMMA RAY BURST SPATIAL DISTRIBUTION **c93**

Jon Hakkila *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 03B

The Burst and Transient Source Experiment (BATSE) on the Gamma Ray Observatory (GRO) is designed to study astronomical gamma ray sources and to provide better positional, spectral, and time resolution about these objects than has previously been possible from one experiment. The procedure to be used in the analysis of the gamma ray burst spatial distribution is presented. Data is input from BATSE via the Gamma Ray Burst Catalog (listing individual burst positions, flux values, and associated errors) and the Sky Sensitivity Map (which summarizes observational selection effects in table format). A FORTRAN program generates Monte Carlo burst catalogs, which are models to be compared to the actual distribution. The Monte Carlo models are then filtered through the Sky Sensitivity Map so that they suffer from the same selection effects as the actual catalog data. Additionally, each burst position is converted into a probability distribution to mimic BATSE positional sensitivity. The Burst Catalog, Monte Carlo burst catalog, and Sky Sensitivity Map are then passed onto an IDL program that compares the catalogs for statistical significance. The Sky Sensitivity Map is used to estimate how often each sky area is observed above the minimum flux level in question. Each burst found in this sky area is then weighted according to the frequency with which this sky area is observed. The catalogs are then compared via tests of homogeneity (based on their radial distributions) and isotropy (based upon their angular distributions). The results of the statistical comparisons along with graphs and charts of the summaries, are output from the IDL program for study. Author

N91-18985*# Tennessee Technological Univ., Cookeville. Dept. of Mechanical Engineering.

IGNITION TRANSIENT ANALYSIS OF SOLID ROCKET MOTOR **c20**

Samuel S. Han *In* Alabama Univ., Research Reports, 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

To predict pressure-time and thrust-time behavior of solid rocket motors, a one-dimensional numerical model is developed. The ignition phase of solid rocket motors (time less than 0.4 sec) depends critically on complex interactions among many elements, such as rocket geometry, heat and mass transfer, flow development, and chemical reactions. The present model solves the mass, momentum, and energy equations governing the transfer processes in the rocket chamber as well as the attached converging-diverging nozzle. A qualitative agreement with the SRM test data in terms of head-end pressure gradient and the total thrust build-up is obtained. Numerical results show that the burning rate in the star-segmented head-end section and the erosive

burning are two important parameters in the ignition transient of the solid rocket motor (SRM). Author

N91-18986*# Alabama A & M Univ., Normal. Dept. of Chemistry.
STRUCTURE FUNCTION CALCULATIONS FOR OSTWALD RIPENING PROCESSES **c25**
Razi A. Hassan *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 07D

A program for computing the structure function for configurations involved in Ostwald Ripening was written. The basic algorithms are derived from a mathematical analysis of a two-dimensional model system developed by Bortz, et. al. (1974). While it is expected that the values form the computer simulations will reflect Ostwald Ripening, at this point the program is still being tested. Some preliminary runs seem to justify the expectations. Author

N91-18987*# Auburn Univ., AL. Dept. of Electrical Engineering.
CURRENT LIMITING REMOTE POWER CONTROL MODULE **c33**
Douglas C. Hopkins *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09A

The power source for the Space Station Freedom will be fully utilized nearly all of the time. As such, any loads on the system will need to operate within expected limits. Should any load draw an inordinate amount of power, the bus voltage for the system may sag and disrupt the operation of other loads. To protect the bus and loads some type of power interface between the bus and each load must be provided. This interface is most crucial when load faults occur. A possible system configuration is presented. The proposed interface is the Current Limiting Remote Power Controller (CL-RPC). Such an interface should provide the following power functions: limit overloading and resulting undervoltage; prevent catastrophic failure and still provide for redundancy management within the load; minimize cable heating; and provide accurate current measurement. A functional block diagram of the power processing stage of a CL-RPC is included. There are four functions that drive the circuit design: rate control of current; current sensing; the variable conductance switch (VCS) technology; and the algorithm used for current limiting. Each function is discussed separately. Author

N91-18988*# New Orleans Univ., LA. Dept. of Mechanical Engineering.
THEORETICAL HYPERVELOCITY BALLISTIC LIMIT FOR SINGLE OR DOUBLE PLATES USING NONLINEAR MODAL ANALYSIS **c39**
David Hui *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20K

The original research on the use on nonlinear vibration technique to solve for the hypervelocity ballistic limit for double plates is examined. Such structure is commonly found in typical Space Station design where the incoming space or man-made debris would be fragmented upon hitting the outer plate (shield) and the subsequent impact on the main wall would result in a much reduced damge of the space station or spacecraft. The existing few theoretical impact equations do not agree well with each other. The existing computer code bumper used at NASA-Johnson Space Center appears to predict an unconservative ballistic limit when compared with experimental data where the velocity ranges from 3 km/s to 8 km/s. Such unconservative prediction is unacceptable from a practical safe design point of view. The bumper code is based on Wilkinson's (1968) paper and his equations have not been improved nor modified even though they are viewed with suspicion due to lack of agreement with experiments. To make matters worse, there is not another theory which is better than Wilkinson's equation and the designers are forced to use purely empirical Nysmith (1969) or semiempirical equations developed by Cour-Palais in 1969. The Cour-Palais equations were later modified empirically in 1989. The purpose of the present investigation is to examine the many assumptions of the Wilkinson equation. An attempt is made to present design charts based on the modified-Wilkinson equation so that the designer can get a feel of the ranges of the parameters which are of interest and discard a huge range of parameters, thus, significantly reducing the number of test shots required. The analysis is based on a solution of the governing nonlinear differential equations for a plate, assuming axisymmetric behavior using polar coordinates. Author

N91-18989*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
SYSTEM IDENTIFICATION AND CONTROLLER DESIGN USING EXPERIMENTAL FREQUENCY RESPONSE DATA **c60**
R. Dennis Irwin *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

Recent findings from modeling and controller design for the NASA-Marshall Single Structure Control Facility have raised questions regarding the ability of modern control design techniques and modern modeling techniques to deal effectively with the stringent modeling and control design requirements of Large Space Structure Control. A brief and general discussion is presented of the results of studies into the modeling and control issues performed under sponsorship of the NASA/ASEE Summer Faculty Fellowship Program. Several issues are addressed. The first is a study of a modeling technique based on least squares identification of individual transfer functions from measured frequency response data. The second is a study of multiobjective optimization techniques applied to the modeling, or system identification, problem. The third issue is a study into the question of whether multiobjective optimization approaches can be effectively used for control system design using only frequency response data, thereby bypassing the difficult modeling problem. The last issue studied involves the resolution of seeming discrepancies between predicted and measured control computer time delays in the Single Structure Control Facility. Author

N91-18990*# Alabama A & M Univ., Normal. Dept. of Food Science and Animal Industries.
A GRAVITATIONAL TEST OF WAVE REINFORCEMENT VERSUS FLUID DENSITY MODELS **c46**
Jacqueline Umstead Johnson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 08G

Spermatozoa, protozoa, and algae form macroscopic patterns somewhat analogous to thermally driven convection cells. These bioconvective patterns have attracted interest in the fluid dynamics community, but whether in all cases these waves were gravity driven was unknown. There are two conflicting theories, one gravity dependent (fluid density model), the other gravity independent (wave reinforcement theory). The primary objectives of the summer faculty fellows were to: (1) assist in sample collection (spermatozoa) and preparation for the KC-135 research airplane experiment; and (2) to collaborate on ground testing of bioconvective variables such as motility, concentration, morphology, etc., in relation to their macroscopic patterns. Results are very briefly given. Author

N91-18991*# Centre Coll. of Kentucky, Danville. Dept. of Mathematics and Science.
REDUCTION OF SOLAR VECTOR MAGNETOGRAPH DATA USING A MICROMSP ARRAY PROCESSOR **c61**
Jack Kineke *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990

5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

The processing of raw data obtained by the solar vector magnetograph at NASA-Marshall requires extensive arithmetic operations on large arrays of real numbers. The objectives of this summer faculty fellowship study are to: (1) learn the programming language of the MicroMSP Array Processor and adapt some existing data reduction routines to exploit its capabilities; and (2) identify other applications and/or existing programs which lend themselves to array processor utilization which can be developed by undergraduate student programmers under the provisions of project JOVE. Author

N91-18992*# Alabama Univ., University. Dept. of Physics and Astronomy.
GAMMA-RAY BURSTS: AN OVERVIEW c93
John Patrick Lestrade *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-008-021)
Avail: NTIS HC/MF A16 CSCL 03B

Gamma Ray Bursts were discovered by researchers studying data from gamma ray detectors aboard the Vela satellites. Since the original discovery, over 500 bursts have been observed by more than a dozen experiments on planetary spacecraft, earth orbiters, balloon flights, and even ground based instruments. Unfortunately, a description of the nature of these transient phenomena is no closer today than two decades ago. Part of the problem lies in the large variability in their physical characteristics. This variability has spawned more than 40 gamma ray burst models. Each model claims some subset of the 500 observed bursts that conclusively proves its validity. A very brief overview is presented of the gamma ray burst phenomenon. Author

N91-18993*# Oakwood Coll., Huntsville, AL. Dept. of Biological Sciences.
VISUALIZATION OF YEAST CHROMOSOMAL DNA c51
Seth Lubega *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 06C

The DNA molecule is the most significant life molecule since it codes the blue print for other structural and functional molecules of all living organisms. Agarose gel electrophoresis is now being widely used to separate DNA of virus, bacteria, and lower eukaryotes. The task was undertaken of reviewing the existing methods of DNA fractionation and microscopic visualization of individual chromosonal DNA molecules by gel electrophoresis as a basis for a proposed study to investigate the feasibility of separating DNA molecules in free fluids as an alternative to gel electrophoresis. Various techniques were studied. On the molecular level, agarose gel electrophoresis is being widely used to separate chromosomal DNA according to molecular weight. Carl and Olson separate and characterized the entire karyotype of a lab strain of Saccharomyces cerevisiae. Smith et al. and Schwartz and Koval independently reported the visualization of individual DNA molecules migrating through agarose gel matrix during electrophoresis. The techniques used by these researchers are being being reviewed in the lab as a basis for the proposed studies.
Author

N91-18994*# Puerto Rico Univ., Rio Piedras. Dept. of Civil Engineering.
TECHNIQUE FOR ASSESSING VEGETATION-INDUCED MOISTURE FLUX, WITH IMPLICATIONS FOR GLOBAL CLIMATE MODELING c45
Emir Jose Macari *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13B

The time between storms, the duration of storms, and the storm depths are studied in relation to vegetation controls on the disposition of rainfall. It is proposed that understanding the movement of water between the vegetation and soil (including evapotranspiration and infiltration) will be the gateway for modeling atmospheric flux and improving global climate models. The overall objective goal of the proposed research effort is to develop a field/lab methodology which will provide a better understanding of vegetation induced water movement. Water flow initiated from stem flow of wooded slopes feeds soil water pathways, which in turn feed the deeper ground water system and give rise to stream response. This is balanced by more water inputs via throughfall, where it percolates the soil matrix and allows much greater rates of evapotranspiration and atmospheric/soil moisture flux. This research study seeks to gain an understanding of the effect of vegetation on soil moisture, and the effect of this differential wetting on resulting evapotranspiration and atmospheric flux. Author

N91-18995*# Harding Coll., Searcy, AR. Dept. of Physical Science.
TEST IMAGES FOR THE MAXIMUM ENTROPY IMAGE RESTORATION METHOD c61
James E. Mackey *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 09B

One of the major activities of any experimentalist is data analysis and reduction. In solar physics, remote observations are made of the sun in a variety of wavelengths and circumstances. In no case is the data collected free from the influence of the design and operation of the data gathering instrument as well as the ever present problem of noise. The presence of significant noise invalidates the simple inversion procedure regardless of the range of known correlation functions. The Maximum Entropy Method (MEM) attempts to perform this inversion by making minimal assumptions about the data. To provide a means of testing the MEM and characterizing its sensitivity to noise, choice of point spread function, type of data, etc., one would like to have test images of known characteristics that can represent the type of data being analyzed. A means of reconstructing these images is presented. Author

N91-18996*# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
FEASIBILITY STUDY OF ROBOTIC NEURAL CONTROLLERS c63
Mario E. Magana *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

The results are given of a feasibility study performed to establish if an artificial neural controller could be used to achieve joint space trajectory tracking of a two-link robot manipulator. The study is based on the results obtained by Hecht-Nielsen, who claims that a functional map can be implemented to a desired degree of accuracy with a three layer feedforward artificial neural network. Central to this study is the assumption that the robot model as well as its parameters values are known. Author

N91-18997*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
NEURAL NETWORKS AS A CONTROL METHODOLOGY c63
Claire L. McCullough *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

While conventional computers must be programmed in a logical fashion by a person who thoroughly understands the task to be performed, the motivation behind neural networks is to develop machines which can train themselves to perform tasks, using available information about desired system behavior and learning

from experience. There are three goals of this fellowship program: (1) to evaluate various neural net methods and generate computer software to implement those deemed most promising on a personal computer equipped with Matlab; (2) to evaluate methods currently in the professional literature for system control using neural nets to choose those most applicable to control of flexible structures; and (3) to apply the control strategies chosen in (2) to a computer simulation of a test article, the Control Structures Interaction Suitcase Demonstrator, which is a portable system consisting of a small flexible beam driven by a torque motor and mounted on springs tuned to the first flexible mode of the beam. Results of each are discussed. Author

N91-18998*# Tennessee Univ., Chattanooga. Dept. of Mechanical Engineering-Mechanics.

THERMAL ANALYSIS SIMULATION FOR A SPIN-MOTOR USED IN THE ADVANCED MAIN COMBUSTION CHAMBER VACUUM PLASMA SPRAY PROJECT USING THE SINDA COMPUTER PROGRAM **c33**

Gary H. McDonald *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09A

One of the many design challenges of this project is predicting the thermal effects due to the environment inside the vacuum chamber on the turntable and spin motor spindle assembly. The objective of the study is to model the spin motor using the computer program System Improved Numerical Differencing Analyzer (SINDA). By formulating the appropriate input information concerning the motor's geometry, coolant flow path, material composition, and bearing and motor winding characteristics, SINDA should predict temperatures at various predefined nodes. From these temperatures, hopefully, one can predict if the coolant flow rate is sufficient or if certain mechanical elements such as bearings, O ring seals, or motor windings will exceed maximum design temperatures. Author

N91-18999*# Wisconsin Univ., Platteville. Dept. of Industrial Engineering.

INFORMATION AND PROBLEM REPORT USAGE IN SYSTEM SAFTEY ENGINEERING DIVISION **c81**

Stephen J. Morrissey *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 05A

Five basic problems or question areas are examined. They are as follows: (1) Evaluate adequacy of current problem/performance data base; (2) Evaluate methods of performing trend analysis; (3) Methods and sources of data for probabilistic risk assessment; and (4) How is risk assessment documentation upgraded and/or updated. The fifth problem was to provide recommendations for each of the above four areas. Author

N91-19000*# University of Southern Alabama, Mobile. Dept. of Civil Engineering.

CONSTRUCTION OF THE 16 METER LARGE LUNAR TELESCOPE (LLT) **c89**

Husam Anwar Omar *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 10 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 03A

The different materials that could be used to design the pedestal for a Moon based 16 meter telescope are discussed. The material that should be used has a low coefficient of thermal expansion, high modulus of elasticity, and high compressive and tensile strengths. For the model developed in this study, an aluminum-manganese alloy was used because of its low coefficient of thermal expansion. Due to variations in lunar soil conditions, both vertically and horizontally, three foundation systems are presented. The spudcan footing can be used in the case where dense soil is more than three meters. The spread footing is recommended where the dense soil is between one and three meters. Finally, in the third system, the Lunar Excursion Vehicle (LEV) is used as a base support for the telescope's pedestal. The LEV support requires a prepared site. The soil should be compacted and stabilized, if necessary, to reduce settlement. Author

N91-19001*# Lenoir-Rhyne Coll., Hickory, NC. Dept. of Physics and Earth Science.

A SURVEY OF TECHNIQUES FOR REFRIGERATION, RELIQUEFACTION, AND PRODUCTION OF SLUSH FOR HYDROGEN **c31**

Dan R. Overcash *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 13B

Several techniques were surveyed for the refrigeration, reliquefaction and production of slush from hydrogen. The techniques included auger; bubbling helium gas; Simon desorption; the Petlier effect; Joule-Kelvin expansion using Stirling, Brayton, and Viulleumirer approaches; rotary reciprocating; a dilution refrigerator; adiabatic demagnetization of a paramagnetic salt; and adiabatic magnetization of a superconductor. Author

N91-19002*# Washington State Univ., Pullman. Dept. of Electrical Engineering.

ELECTRON TEMPERATURE AND CONCENTRATION IN A THERMAL ATOMIC OXYGEN SOURCE **c72**

Patrick Dennis Pedrow *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20H

A thermal atomic oxygen source for materials screening was built for NASA by Boeing Aerospace. The objective here was to use a microwave interferometer and Langmuir probe to characterize the electron concentration in this thermal atomic oxygen source. Typical operating conditions in the thermal atomic oxygen source were found to produce electron concentrations that were well below the detection threshold of the interferometer (10(exp 8) cm (sup -3)). The researchers calibrated (with the interferometer) the Langmuir probe at an artificially high plasma density and then used the circular and the square Langmuir probes to measure the low electron concentrations that exist during materials exposure tests. Electron concentration was measured as a function of power and position. The electrons were lost to the walls through ambipolar diffusion, and their concentration was accurately described by an equation. The electron concentration was proportional to power squared and decayed exponentially with distance. Author

N91-19003*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.

ANALYTICAL STUDY OF THE EFFECTS OF CLOUDS ON THE LIGHT PRODUCED BY LIGHTNING **c47**

Dieudonne D. Phanord *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 9 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 04B

Researchers consider the scattering of visible and infrared light due to lightning by cubic, cylindrical and spherical clouds. The researchers extend to cloud physics the work by Twersky for single and multiple scattering of electromagnetic waves. They solve the interior problem separately to obtain the bulk parameters for the scatterer equivalent to the ensemble of spherical droplets. With the interior solution or the equivalent medium approach, the multiple scattering problem is reduced to that of a single scatterer in isolation. Hence, the computing methods of Wiscombe or Bohren specialized to Mie scattering with the possibility for absorption were used to generate numerical results in short computer time. Author

N91-19004*# West Virginia Inst. of Tech., Montgomery. Dept. of Electrical Engineering.

DEVELOPMENT OF SEDS DATA SYSTEM FLIGHT SOFTWARE c61

William E. Pierson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

The Small Expendable-tether Deployer System (SEDS) is being built for a 1991 flight on a Delta launch vehicle. SEDS will deploy a 50 lb instrument satellite as an end mass at the end of a 20 km tether. The objective of the experiment is to test the SEDS design concept by demonstrating that the system will satisfactorily deploy the full 20 km tether without stopping prematurely, come to a smooth stop on application of the brake, and cut the tether at the proper time after it swings to the vertical. SEDS will also collect data that will be used to test the accuracy of tether dynamics models for this type of deployment. Radar tracking is planned. In addition, the SEDS on-board computer system will record, store, and continuously transmit data over the Delta II S-band telemetry channel. Initial testing of the software under simulated flight conditions was performed. These tests used both assembly language routines running on SEDS data systems and C-language routines on an IBM-PC. As the software now stands relatively few additions are needed before the entire set of flight software is complete. Author

N91-19005*# Alabama Univ., Tuscaloosa. Dept. of Industrial Engineering.

EMERGENCY EGRESS REQUIREMENTS FOR SPACE STATION FREEDOM c18

Paul S. Ray *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

There is a real concern regarding the requirements for safe emergency egress from the Space Station Freedom (SSF). The possible causes of emergency are depressurization due to breach of the station hull by space debris, meteoroids, seal failure, or vent failure; chemical toxicity; and a large fire. The objectives of the current study are to identify the tasks required to be performed in emergencies, establish the time required to perform these tasks, and to review the human equipment interface in emergencies. It was found that a fixed time value specified for egress has shifted focus from the basic requirements of safe egress, that in some situations the crew members may not be able to complete the emergency egress tasks in three minutes without sacrificing more than half of the station, and that increased focus should be given to human factors aspects of space station design. Author

N91-19006*# Alabama Univ., Huntsville. Dept. of Civil Engineering.

THE EFFECT OF FRICTION IN THE HOLD DOWN POST SPHERICAL BEARINGS ON HOLD DOWN POST LOADS c37

James A. Richardson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 8 p (For primary document see N91-18967 10-99)
Avail: NTIS HC/MF A16 CSCL 13K

The effect of friction at the connection of the Solid Rocket Booster (SRB) aft skirt and the mobile launch platform (MLP) hold down posts was analyzed. A simplified model of the shuttle response during the Space Shuttle Main Engine (SSME) buildup was constructed. The model included the effect of stick-slip friction for the rotation of the skirt about the spherical bearing. Current finite element models assume the joint is completely frictionless in rotation and therefore no moment is transferred between the skirt and the hold down posts. The model was partially verified against test data and preliminary parameter studies were performed. The parameter studies indicated that the coefficient of friction strongly influenced the moment on the hold down posts. The coefficient of friction had little effect on hold down post vertical loads, however. Further calibration of the model is necessary before the effect of friction on the hold down post horizontal loads can be analyzed. Author

N91-19007*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.

CHARACTERIZATION OF SPACE STATION MULTILAYER INSULATION DAMAGE DUE TO HYPERVELOCITY SPACE DEBRIS IMPACT c18

William Keith Rule *In its* Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

Four main tasks were accomplished. The first three tasks were related to the goal of measuring the degradation of the insulating capabilities of Space Station multilayer insulation (MLI) due to simulated space debris impacts at hypervelocities. The last task was associated with critically reviewing a Boeing document on the fracture characteristics of the Space Station pressure wall when subjected to a simulated hypervelocity space debris impact. In Task 1, a thermal test procedure for impact damaged MLI specimens was written. In Task 2, damaged MLI specimens were prepared. In Task 3, a computer program was written to simulate MLI thermal tests. In Task 4, the author reviewed a Boeing document describing hypervelocity impact testing on biaxially stressed plates. Author

N91-19008*# Christian Brothers Coll., Memphis, TN. Dept. of Mechanical Engineering.

VALIDATION OF THE SPACE SHUTTLE MAIN ENGINE STEADY STATE PERFORMANCE MODEL c29

L. Michael Santi *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 9 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21H

The primary objective was to present methods for validating predictions of Rocketdyne's most current version of the Space Shuttle Main Engine (SSME) Power Balance Model (PBM) with respect to physical relations governing flow systems. This required the development and implementation of postprocessors to check results of PBM computations for satisfaction of conservation relations. A cursory uncertainty analysis of PBM predictions with respect to mass and energy balances was performed. In addition, an effort to identify the empirical relations and physical assumptions within PBM which impact the ability of the model to attain rigorous balance was begun. Author

N91-19009*# Florida International Univ., Miami. Dept. of Physics.

HIGH VOLTAGE PLASMA SHEATH ANALYSIS RELATED TO TSS-1 c75

John W. Sheldon *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 4 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 20I

On the first mission of the Tethered Satellite System (TSS-1), a 1.8 m diameter spherical satellite will be deployed a distance of 20 km above the Space Shuttle Orbiter on an insulated conducting tether. The satellite will be held at electric potentials up to 5000 volts positive with respect to the ambient plasma. Due to the passage of the conducting tether through the Earth's magnetic field, an electromagnetic field (EMF) will be created, driving electrons down the tether to the Orbiter, out through an electron gun into the ionosphere and back into the positive-biased satellite. The main problem addressed here is the current-voltage characteristics of the ionospheric interaction with the satellite. The first problem is that while the satellite will be capable of measuring charged particle flow to the surface at several locations, the detectors have a limited range of acceptance angle. The second problem is that the angle of incidence of the incoming electrons

will have to be relative to the local normal. This will be important in order to predict the magnitude of the detectable current at each detector location so the detector gain can be pre-set to the correct range. The plasma sheath was analyzed mathematically, and subroutines were written to solve relevant finite element, Taylor-Vlasov, and Poisson equations. Author

N91-19010*# Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
A STUDY OF THE CURRENT GROUP EVAPORATION/COMBUSTION THEORIES **c25**
Hayley H. Shen *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 21B

Liquid fuel combustion can be greatly enhanced by disintegrating the liquid fuel into droplets, an effect achieved by various configurations. A number of experiments carried out in the seventies showed that combustion of droplet arrays and sprays do not form individual flames. Moreover, the rate of burning in spray combustion greatly deviates from that of the single combustion rate. Such observations naturally challenge its applicability to spray combustion. A number of mathematical models were developed to evaluate 'group combustion' and the related 'group evaporation' phenomena. This study investigates the similarity and difference of these models and their applicability to spray combustion. Future work that should be carried out in this area is indicated. Author

N91-19011*# Alabama Univ., Huntsville. Dept. of Computer Science.
DEVELOPMENT OF NICKEL HYDROGEN BATTERY EXPERT SYSTEM **c33**
Sajjan G. Shiva *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 10C

The Hubble Telescope Battery Testbed employs the nickel-cadmium battery expert system (NICBES-2) which supports the evaluation of performances of Hubble Telescope spacecraft batteries and provides alarm diagnosis and action advice. NICBES-2 also provides a reasoning system along with a battery domain knowledge base to achieve this battery health management function. An effort to modify NICBES-2 to accommodate nickel-hydrogen battery environment in testbed is described. Y.S.

N91-19012*# Louisiana Coll., Pineville. Dept. of Mathematics and Computer Science.
A HIGH-FIDELITY SATELLITE EPHEMERIS PROGRAM FOR EARTH SATELLITES IN ECCENTRIC ORBITS **c13**
David R. Simmons *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22A

A program for mission planning called the Analytic Satellite Ephemeris Program (ASEP), produces projected data for orbits that remain fairly close to the Earth. ASEP does not take into account lunar and solar perturbations. These perturbations are accounted for in another program called GRAVE, which incorporates more flexible means of input for initial data, provides additional kinds of output information, and makes use of structural programming techniques to make the program more understandable and reliable. GRAVE was revised, and a new program called ORBIT was developed. It is divided into three major phases: initialization, integration, and output. Results of the program development are presented. Y.S.

N91-19013*# Wichita State Univ., KS. Dept. of Mechanical Engineering.
HEAT SINK EFFECTS IN VPPA WELDING **c37**
Paul O. Steranka, Jr. *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

The development of a model for prediction of heat sink effects associated with the Variable Polarity Plasma Arc (VPPA) Welding Process is discussed. The long term goal of this modeling is to provide means for assessing potential heat sink effects and, eventually, to provide indications as to changes in the welding process that could be used to compensate for these effects and maintain the desired weld quality. In addition to the development of a theoretical model, a brief experimental investigation was conducted to demonstrate heat sink effects and to provide an indication of the accuracy of the model. Y.S.

N91-19014*# New Mexico Highlands Univ., Las Vegas. Dept. of Engineering Technology.
BIOREGENERATIVE LIFE SUPPORT **c54**
Bill Taylor *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 06K

Bioregenerative life support systems utilize plant growth for food, water, and atmosphere revitalization. Simulation studies of a simplified model are presented that suggest survivability in the face of partial plant growth chamber failure. Simulation studies demonstrate the potential for a bioregenerative life support system on an extended mission. In addition to robustness and survivability in terms of the food supply, the plant growth chamber produces exactly the right amount of oxygen for the crew's metabolic needs. The amount of water taken up by the plants during food production is balanced by the crew's metabolic water production. Y.S.

N91-19015*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
FREQUENCY RESPONSE OF ELECTROCHEMICAL CELLS **c44**
Daniel L. Thomas *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 10A

The main objective was to examine the feasibility of using frequency response techniques (1) as a tool in destructive physical analysis of batteries, particularly for estimating electrode structural parameters such as specific area, porosity, and tortuosity and (2) as a non-destructive testing technique for obtaining information such as state of charge and acceptability for space flight. The phenomena that contribute to the frequency response of an electrode include: (1) double layer capacitance; (2) Faradaic reaction resistance; (3) mass transfer of Warburg impedance; and (4) ohmic solution resistance. Nickel cadmium cells were investigated in solutions of KOH. A significant amount of data was acquired. Quantitative data analysis, using the developed software, is planned for the future. Y.S.

N91-19016*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
DESIGN AND IMPLEMENTATION OF A GROUND CONTROL CONSOLE PROTOTYPE FOR OMV **c14**
Bruce L. Walcott *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 14B

One of the primary uses of the Flat Floor facility of The Marshall Flight Center is to perform autonomous and teleoperated docking of vehicles similar to NASA's Orbital Maneuvering Vehicle (OMV). Using both the air-bearing vehicle and the 8 DOF Dynamic Overhead Target Simulator (DOTS) in tandem, even the most difficult OMV docking problems can be simulated. The OMV was

planned to be flown from the ground by a pilot via teleoperation. Specifications were developed for a prototype Ground Control Console (GCC) from where the vehicle will be flown. In order for testing of the OMV to occur at Flat Floor facility, this GCC must be replicated. The project was divided into three primary tasks: (1) the design and development of the video display; (2) the design and development of the switch panel using the micro switch programmable display pushbutton switches; and (3) the design and development of the hand controllers. A final task is to perform system integration on the results of these three primary tasks. Y.S.

N91-19017*# California Polytechnic State Univ., San Luis Obispo. Dept. of Materials Engineering.

CHARACTERIZATION OF THE CORROSION RESISTANCE OF SEVERAL ALLOYS TO DILUTE BIOLOGICALLY ACTIVE SOLUTIONS **c26**

Daniel W. Walsh *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 7 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

Sulfate reducing bacteria and acid producing bacteria/fungi detected in hygiene waters increased the corrosion rate in aluminum alloy. Biologically active media enhanced the formation of pits on metal coupons. Direct observation of gas evolved at the corrosion sample, coupled with scanning electron microscopy (SEM) and energy dispersive x-ray analysis of the corrosion products indicates that the corrosion rate is increased because the presence of bacteria favor the reduction of hydrogen as the cathodic reaction through the reaction of oxygen and water. SEM verifies the presence of microbes in a biofilm on the surface of corroding samples. The bacterial consortia are associated with anodic sites on the metal surface, aggressive pitting occurs adjacent to biofilms. Many pits are associated with triple points and inclusions in the aluminum alloy microstructure. Similar bacterial colonization was found on the stainless steel samples. Fourier transform Infrared Spectroscopy confirmed the presence of carbonyl groups in pitted areas of samples exposed to biologically active waters. Author

N91-19018*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.

GRAPHICS MODELLING OF NON-CONTACT THICKNESS MEASURING ROBOTICS WORK CELL **c61**

Charles W. Warren *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 09B

A system was developed for measuring, in real time, the thickness of a sprayable insulation during its application. The system was graphically modelled, off-line, using a state-of-the-art graphics workstation and associated software. This model was to contain a 3D color model of a workcell containing a robot and an air bearing turntable. A communication link was established between the graphics workstations and the robot's controller. Sequences of robot motion generated by the computer simulation are transmitted to the robot for execution. Y.S.

N91-19019*# Texas A&M Univ., College Station. Dept. of Electrical Engineering.

IMPLEMENTATION STRATEGIES FOR LOAD CENTER AUTOMATION ON THE SPACE STATION MODULE/POWER MANAGEMENT AND DISTRIBUTION TESTBED **c18**

Karen Watson *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 6 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

The Space Station Module/Power Management and Distribution (SSM/PMAD) testbed was developed to study the tertiary power management on modules in large spacecraft. The main goal was to study automation techniques, not necessarily develop flight ready systems. Because of the confidence gained in many of automation strategies investigated, it is appropriate to study, in more detail, implementation strategies in order to find better trade-offs for nearer to flight ready systems. These trade-offs particularly concern the weight, volume, power consumption, and performance of the automation system. These systems, in their present implementation are described. Y.S.

N91-19020*# Utah State Univ., Logan. Dept. of Industrial Technology.

CHARACTERIZATION OF WELDED HP 9-4-30 STEEL FOR THE ADVANCED SOLID ROCKET MOTOR **c26**

George William Watt *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 11F

Solid rocket motor case materials must be high-strength, high-toughness, weldable alloys. The Advanced Solid Rocket Motor (ASRM) cases currently being developed will be made from a 9Ni-4Co quench and temper steel called HP 9-4-30. These ultra high-strength steels must be carefully processed to give a very clean material and a fine grained microstructure, which insures excellent ductility and toughness. The HP 9-4-30 steels are vacuum arc remelted and carbon deoxidized to give the cleanliness required. The ASRM case material will be formed into rings and then welded together to form the case segments. Welding is the desired joining technique because it results in a lower weight than other joining techniques. The mechanical and corrosion properties of the weld region material were fully studied. Y.S.

N91-19021*# Auburn Univ., AL. Dept. of Mechanical Engineering.

VERIFICATION OF COMPONENT MODE TECHNIQUES FOR FLEXIBLE MULTIBODY SYSTEMS **c18**

Gloria J. Wiens *In* Alabama Univ., Research Reports: 1990 NASA/ASEE Summer Faculty Fellowship Program Oct. 1990 5 p (For primary document see N91-18967 10-99)
(Grant NGT-01-002-099)
Avail: NTIS HC/MF A16 CSCL 22B

Investigations were conducted in the modeling aspects of flexible multibodies undergoing large angular displacements. Models were to be generated and analyzed through application of computer simulation packages employing the 'component mode synthesis' techniques. Multibody Modeling, Verification and Control Laboratory (MMVC) plan was implemented, which includes running experimental tests on flexible multibody test articles. From these tests, data was to be collected for later correlation and verification of the theoretical results predicted by the modeling and simulation process. Y.S.

N91-19022*# National Aeronautics and Space Administration, Washington, DC.

AERONAUTICS AND SPACE REPORT OF THE PRESIDENT Activities Report, 1988

1990 200 p
(NASA-TM-103371; NAS 1.15:103371) Avail: NTIS HC/MF A09 CSCL 05A

Nineteen eighty-eight marked the United States' return to space flight with two successful space shuttle launches in September and December, as well as six successful expendable rocket launches. Meanwhile, many other less spectacular but important contributions were made in aeronautics and space by the 14 participating government organizations. Each organization's aeronautics and/or space activities for the year are presented. The organizations involved include: (1) NASA; (2) Department of Defense; (3) Department of Commerce; (4) Department of Energy; (5) Department of the Interior; (6) Department of Agriculture; (7) Federal Communications Commission; (8) Department of Transportation; (9) Environmental Protection Agency; (10) National Science Foundation; (11) Smithsonian Institution; (12) Department of State; (13) Arms Control and Disarmament Agency; and (14) United States Information Agency. K.S.

N91-19023*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
RESEARCH AND TECHNOLOGY Annual Report, 1990
Dec. 1990 139 p
(NASA-TM-103811; NAS 1.15:103811) Avail: NTIS HC/MF A07 CSCL 05A

As the NASA center responsible for assembly, checkout, servicing, launch, recovery, and operational support of Space Transportation System elements and payloads, Kennedy Space Center (KSC) is placing increasing emphasis on KSC's research and technology program. In addition to strengthening those areas of engineering and operations technology that contribute to safer, more efficient, and more economical execution of the current mission, the technological tools needed to execute KSC's mission relative to future programs are being developed. The Engineering Development Directorate encompasses most of the laboratories and other KSC resources that are key elements of research and technology program implementation and is responsible for implementation of the majority of the projects in this KSC 1990 annual report. Projects under the following topics are covered: (1) materials science; (2) hazardous emissions and contamination monitoring; (3) biosciences; (4) autonomous systems; (5) communications and control; (6) meteorology; (7) technology utilization; and (8) mechanics, structures, and cryogenics. Author

N91-18152*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
PROJECT SUMMARIES, 1989 - 1990
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 203-208 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 22A

N91-18153*# Texas Univ., Austin.
PROJECT SUMMARIES
In USRA, Proceedings of the 6th Annual Summer Conference: NASA/USRA University Advanced Design Program Nov. 1990 p 209-212 (For primary document see N91-18121 10-12)
Avail: NTIS HC/MF A14 CSCL 05A

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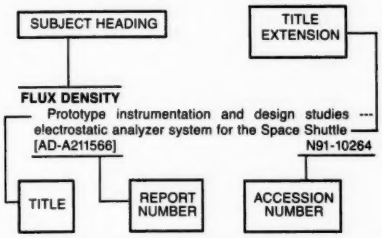

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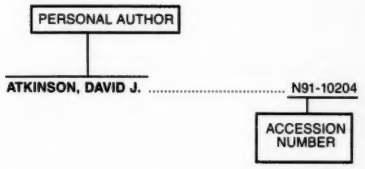

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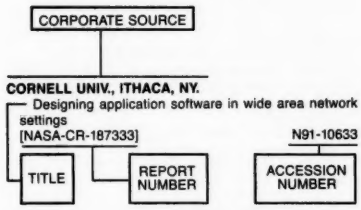

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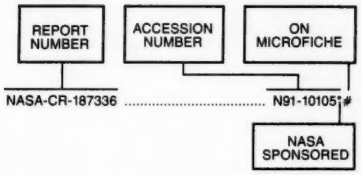

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